ARCHIVES

OF

OPHTHALMOLOGY

AND

OTOLOGY.

EDITED AND PUBLISHED SIMULTANEOUSLY IN ENGLISH AND GERMAN.

BY

PROF. H. KNAPP, M.D., AND PROF. S. MOOS, M.D.,

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CONTENTS.

PROSPECTUS.

THE physiological connection between the organs of sight and hearing has at all times been deemed by eminent naturalists a good reason and a powerful incentive for extending their investigations over both the eye and ear, and the late researches of Professors *M. Schultze* and *H. Helmholtz* are but another and a most brilliant illustration of this truth.

The wide field of scientific exploration, opened by the invention of the ophthalmoscope and the discovery of many other methods of physiological and anatomical inquiry, led to so many questions of practical application that the most talented and persevering medical men found ample occupation in the study and practice of either ophthalmology or otology. By this division of labor an unexpectedly rapid progress was achieved in each of these departments, which now begin to be so well defined and understood that, henceforth, a conscientious student will hardly be satisfied with limiting his knowledge to one single organ, but will, on the contrary, by reason of the many analogies between them, irresistibly be led from ophthalmology to otology, or vice versa, yielding to the same influences and reaping the same

benefits as anatomists and physiologists, the vanguard of physicians, did at an earlier date.

But, aside from the natural affinity of these two branches, it will be proper to remember that, the number of oculists having so much increased during the last decade, it will not be wise for the younger generation to rely with too much confidence on ophthalmic surgery exclusively.

Literary production, especially that in scientific periodicals, is a true reflection of the scientific attempts and achievements in the theoretical as well as practical field. Whenever the discovery of new sources of investigation suddenly attracts a superabundant amount of intellectual activity toward one special branch, there will at once spring up a luxuriant growth of special literature; and, when these sources prove to be inexhaustible, and the results of the scientific labor bestowed upon them admit of an extensive practical application, then this special literature will not be ephemeral, but take lasting root and grow vigorously.

These observations of a general character will naturally lead to a *survey of the present state of ophthalmology and otology*. We should be bold indeed, if we were to expect from the next two decades so many brilliant discoveries as the last two have given to the scientific world. Nevertheless, research in ophthalmic as well as in aural surgery is still necessary, productive, and full of promise. A great many questions yet remain unanswered; many morbid and even physiological conditions have to be elucidated; and most, we might say all, the results of

modern science in these two specialties are yet of so recent a date, that it would be difficult to denote any one point which might not profitably be subjected to renewed searching scrutiny.

When, as we have set forth, the close relationship between ophthalmology and otology, the present greater facilities of acquiring thorough knowledge in both, and the increasing number of oculists, *render the combination of ophthalmic and aural surgery most advisable*, then we must consider the publication of these Archives as being not only justifiable, but highly opportune. *In America they may be looked upon as an actual necessity*, since in the whole of this vast and rising country no journal either of ophthalmology or otology exists.

The relations of different peoples, growing from year to year freer and more intimate, correspondingly divest most branches of science of their national physiognomy, rendering them a boon common to all. What was prepared or detected in one country, is refined and developed in the other, and brought to practical and general application in the third.

In consideration of the true *international character of medical science*, the Editors have decided to publish the "Archives of Ophthalmology and Otology" simultaneously at New York and Carlsruhe, in the English and German languages. Contributors will not fail to appreciate the unusual advantage of having their discoveries and researches immediately promulgated in the two most wide-spread idioms of the civilized world.

The purpose of this periodical is not only to diffuse

knowledge among the medical profession, but to act as a stimulus for scientific investigation. Ophthalmic and aural surgeons will promote their own interest and that of science by publishing the results of their studies and experience in a *special organ*, for many valuable observations are apt to be overlooked and lost when scattered among the diversified contents of general medical journals.

The "Archives" will be open to *original communications* only, relating either to the pure anatomy and physiology, or to the pathology and therapeutics of the organs of sight and hearing. Every article should be written in such a way that its length will not be disproportionate to the amount of new and instructive material furnished by it.

The "Archives of Ophthalmology and Otology" will appear in the form and size of this Prospectus, and be printed on the same quality of paper. No expense shall be spared in the matter of woodcuts, lithographs and chromo-lithographs. It is the intention of the Editors to issue the "Archives" half-yearly, in spring and autumn, by separate independent numbers, each to contain about 250 to 300 pages, and two numbers to form a volume.

The Editors congratulate themselves on being able to announce that a great many most eminent ophthalmologists and otologists, both of Europe and the United States, have expressed a deep interest in, and promised their active co-operation with the objects of these Archives. The different places of residence of the two

Editors will, in the present state of the transatlantic mail-service, occasion no delay in the publication of a work in semi-annual numbers.

Communications—which are respectfully solicited—may be addressed to either of the undersigned Editors.

PROF. H. KNAPP, M.D.,
No. 25 West 24th Street, New York.

PROF. S. MOOS, M.D.,
Heidelberg (Germany).

The publishers take pleasure in announcing that the first number of the "Archives" will be issued some time in May, and will consist of about 300 octavo pages of entirely original matter, contributed by men of eminence in this country and in Europe; fully illustrated by fine engravings and superb chromo-lithographic plates.

The second number will appear about six months thereafter, the two numbers forming one very handsome volume, replete with articles of standard value, not only to the professed ophthalmologist and otologist, but also to the general practitioner.

As the number of plates imported from Germany for the first number is not large, the edition will be limited, and those who desire to subscribe should at once send their names and addresses, accompanied with the subscription price, to

WM. WOOD & CO., *Publishers*,
NEW YORK.

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ENTOPTIC PHENOMENA CONNECTED WITH THE CIRCULATION OF THE BLOOD.

BY B. A. POPE, M. D.,

Lecturer on the Eye and Ear in the University of Louisiana, New Orleans.

IN looking through a dark-blue glass at a bright sky numerous luminous figures in rapid motion appear over the whole field of vision, except in a small space at its center. Their movements are independent of those of the eye. The number of these bodies appearing in a given space varies very much at different moments. Their typical form is that of the letter S, though many never reach it, and some few even appear only for an instant, and then simply as luminous points. They are of a brilliant white, the degree of which, however, varies in the different figures. Continuous with and following the luminous band is a shadowy portion, the distinctness of which also varies.

Attending the motions of these bodies in my eye there is a *distinct* and *regular pulsatory movement coinciding* with

the pulse at the *wrist.* This is best observed when the figures are very distinct, and the attention is not too much concentrated upon any one portion of the field of vision. The pulse is marked by the sudden and uniform increase in the rapidity of the movement of the luminous bands.

In performing this experiment, I have found it best to *close* and *cover* one eye.

Simultaneously with the *luminous bands* I have been able to observe the appearance of *currents* (disks), which two phenomena seem to be projected in different planes; the *luminous bands* appearing to be nearest the eye. In performing this experiment, I first brought into view the currents, and then suddenly placed a blue glass before the eye. Both of these appearances are, however, best observed separately.

Both the luminous bands and the currents or disks have been described by *Vierordt*, *Meisner*, *Ludwig*, *Helmholtz*, and others. *Vierordt*, who seems to have seen the currents very plainly, brought them best into view by gazing on a highly luminous surface for a short time, and then rapidly passing the separated fingers from side to side, between the luminous surface and his eye. The appearance of currents is caused by innumerable disks moving uniformly in fixed paths. When observed by me, upon looking at a highly illuminated surface, the disks are white or yellow, or some are white and some yellow. When the disks are projected upon a slightly luminous white surface, they are of a luminous grayish white. They are always a mixture of blue and yellow when observed through a blue glass, or when a

blue glass or blue card is passed rapidly from side to side, between the eye and the luminous surface.

I have not been able to convince myself that there is any *interruption* in the *currents at* the *point* of *fixation*. One difficulty in the way of accurate observation is the blinding effect of the light, which is most decidedly felt at the macula lutea.

By looking upon a highly luminous surface, and passing the open fingers rapidly from side to side between my eye and the light, the disks in motion first appear, then they seem tc form currents not distinctly bounded, and at last the whole field darkens, commencing at the center, and becomes mapped out into disk currents and interspaces. The interspaces occupy comparatively but a small space. After repeating this experiment a few times, the eye becomes much fatigued, and the central portion of the field remains darkened for some time, so as to interfere very much with the use of the eyes. This is principally the case with my right eye.

By simply looking at a slightly illuminated white surface, and allowing the light from a brilliant lamp, placed a little to one side and nearer the eye, to fall upon the retina, the currents appear in my eyes, especially in the left, with great ease and distinctness. It facilitates very greatly the production of the currents if, instead of fixing the attention upon the surface upon which they are projected, I gaze at a point far beyond; still this is not absolutely necessary, for to a great extent their appearance is independent of the state of the accommodation. If my eye be accommodated

sharply for a point upon the surface upon which the currents have been projected, they do not seem to reach the center of the field, and at times I can voluntarily vary the diameter of this space free from the currents, without any seemingly great change in the condition of the accommodation. It is quite easy to make this central deficiency of the currents disappear. At times the currents appear to me by looking simply at a moderately illuminated white surface. Frequently when the whole field of vision is darkened and mapped out into currents, they *suddenly* disappear entirely, and with their disappearance there is a cessation of the feeling of strain and of effort. Complicating these experiments, and rendering the influence of the state of the accommodation upon the production of the currents uncertain, is the fact that I find the covered eye deviated inward, when the currents are seen in their greatest perfection. I am almost certain that the sudden disappearance of the currents, which frequently occurs in my right eye, is connected with the sudden cessation of this strabismus. Upon this fact also seemingly depends the feeling of strain and of effort felt during the experiments. The feeling of strain is generally in the eye used. The fact that one eye is better adapted to the performance of these experiments probably depends, at least in part, upon the greater ease with which this strabismus internus is produced in one eye than in the other. Frequent pressure of the eyeball with the lids seems to favor the performance of the experiment.

At times slight pressure upon the closed eyelids turned from the light brings again into view the currents in a re-

markably distinct manner ; but this seems to be an exceptional occurrence.

By looking through a small opening in a card at a highly illuminated surface, and making slight movements of the card, the finest retinal vessels entoptically visible, appear to me with remarkable distinctness. At the same time, by increasing the movements of the card, the currents appear in an *entirely distinct* and *more remote plane.* Of course the two phenomena can not be seen at the same time in the greatest perfection of each ; but it is easy to determine, that without doubt the phenomenon of currents has nothing whatever to do with what transpires in the finest visible retinal vessels running to the macula lutea. While observing these two phenomena, the apparent size of the corpuscles is larger than that of the smaller vessels, and the currents appear much larger than do the largest vessels in the neighborhood of the macula lutea, In this experiment, also, I can not see that the currents are deficient at the point of fixation. At times there is an apparent deficiency, seemingly growing out of the blinding effect of the light.

Only in the experiment first mentioned, have I been able to observe the currents (disks) and the luminous bands simultaneously.

The capillary circulation, visible entoptically in the form of currents, takes place in a plane nearer to the percipient layer of the retina than are the finest retinal vessels entoptically visible. This fact can only be explained, by assuming either that a layer of capillary vessels exists in the retina nearer to the percipient layer than the finest retinal ves-

sels entoptically visible, or that the currents depend upon the circulation in the choriocapillaris. Moreover, if there be in reality no interruption in the currents in the central portion of the field of vision, it is necessary to seek their cause in the choriocapillaris. The latter is nearer to the percipient layer of the retina than are the retinal capillaries, but this fact does not throw much light upon the subject in the present state of our knowledge. It does not seem impossible, that by illuminating the choroidea and sclerotica, objects placed immediately behind the retina might become entoptically visible, especially if there should be a deficiency in the amount of pigment in the choroidea.

As has been already remarked, it seems to me that the luminous bands appear in a plane nearer the eye than do the disks. The proof that the causes of these two phenomena lie in different planes does not depend upon this observation alone; for it has been experimentally proven by *Helmholtz*, that the luminous bands must be placed in connection with the circulation in the retinal vessels entoptically visible; while one of the above-described experiments demonstrates the total want of connection between the visible retinal vessels and the currents.

Helmholtz explains the appearance of the luminous bands by supposing that temporary interruption to the circulation in some of the retinal capillaries occurs, caused by the larger blood globules blocking the blood channels, and causing collapse of the capillaries in front and accumulation of blood globules behind. The brilliant portion of the figures, he thinks to be caused by the collapsed portion of

the vessel, and the shadowy portion by the accumulated blood globules.

That the appearance of disk currents can not receive the same explanation, seems highly probable from the following summary of facts, as observed in the experiments made with my eyes.

The luminous bands are best seen by softening the light by means of a deep-blue glass, and by closing and covering one eye, while looking, *without effort*, at a light sky. The currents are best seen by looking at the luminous surface, or upon a surface to one side of the strong light, without a glass, one eye being covered, but not closed.

In covering the eye, it should not be *totally excluded* from the *entrance* of *light*, but simply excluded from taking direct part in the experiment, a certain amount of light being allowed to enter from the sides. I have frequently observed, that when the currents were most perfectly seen, they could be made to disappear immediately by cutting off the light as far as possible. Frequently, after causing the currents to disappear in this manner, they would return at once to view upon allowing a little lateral diffused light to enter. These facts are especially well observed in the experiment where the disk currents are projected upon a moderately illuminated, slightly roughened, white surface.

Instead, however, of looking at the luminous surface without effort, I find it best to look toward it, but as though looking as far as possible beyond, with an effort that causes strabismus internus in the covered eye, and a decidedly unpleasant feeling of strain, especially in the eye used. The

luminous bands disappear upon ceasing to look upon the luminous surface, while the currents may appear some time after the experiments have been made, and this too with the eyes closed and turned from the light. The luminous bands are *isolated*, whereas numerous *disks* pass along the *same* path. The luminous bands appear and disappear suddenly, and return again at the same point at irregular intervals of time, while the currents never intermit, and the individual disks only disappear by passing beyond the point of observation, or becoming lost in the mass of accompanying disks. The luminous bands vary in size and brilliancy, but the disks are uniform in size and brilliancy as seen in any given experiment, The bands are bright, white images, while the disks are yellow, or a part yellow and a part blue, or in some experiments they are of a luminous grayish white color. In my eye, the luminous bands show a regular pulsatory movement, synchronous with the pulse at the wrist. This I have never found absent in either eye, though probably seen plainest in the left; and it becomes more evident in proportion as the luminous bands become more brilliant. This pulsatory movement, I have never observed in the disks. In the *interval* between *any two pulsatory movements*, luminous bands may *appear* and *disappear*. The currents certainly pass beyond the limits in which the luminous bands appear in the central portion of the field of vision. The luminous bands are seen with almost equal ease for an indefinite period, under the same conditions; but the power of observing the currents may be temporarily almost entirely lost.

Whether the blood globules make themselves visible entoptically as disks, by acting upon the light as small lenses, or in some other manner, it would be difficult to say with any great degree of certainty.

The demonstration of a capillary pulse would seem to be of great importance in reference to the question of the influence of the heart's action upon the circulation of the blood through the capillary system.

The ophthalmoscope has revealed the fact that under certain conditions of intraocular pressure a pulsation may be observed in the large retinal vessels. The possibility of demonstrating a retinal capillary pulsation may prove to be also of value in cases of increased intraocular pressure. There is some reason, also, for believing that the entoptic currents and luminous bands may be used as aids in the diagnosis of diseases of the retina, and possibly of those of the choroidea also.

NOTE.—My eyes, optically considered, are about normal, the intraocular pressure probably reaches the highest normal limits, and I have the power of producing a slight strabismus externus when looking in the distance, or when one eye is covered but not closed. My eyes are blue, complexion fair, and hair dark brown, with corresponding pigmentation of the choroidea.

THE EXTIRPATION OF THE FIBRO-CARTILAGE OF THE UPPER EYELIDS FOR THE CURE OF CERTAIN CASES OF ENTROPION AND TRICHIASIS.

By DR. B. A. POPE, of New Orleans.

There are certain extreme cases of atrophy of the cartilages and conjunctivæ of the upper eyelids, with inversion of their free margins, in which the operations heretofore proposed and practiced have not given entirely satisfactory results. In these cases the eyelashes are often well preserved, and even luxuriant in growth, though long in contact with the eyeballs and bathed in the conjunctival secretions. The meibomian glands are entirely destroyed, and the openings of the lids very much narrowed (palpebral phimosis). The cartilages are much lessened, in both their horizontal and their vertical diameters, and greatly thickened, and very convex on their outer surfaces.

The disease known as Trachoma is the only one capable of producing the above-described changes. And even in this disease it is only in those cases where the so-called granulations have involved the cartilages profoundly. In

addition, the disease must have been greatly neglected, which often occurs where it progresses insidiously without producing catarrhal, or purulent ophthalmia, and without affecting the cornea.

Until a year past, I have operated upon all such cases as have been just described by modifying the operation of *Arlt*, itself a modification of an operation proposed by *Jäsche.* The operation as performed by Arlt consists in the division of the lower part of the lid into an anterior and a posterior flap. The anterior flap is composed of the skin, muscle, and hair bulbs. The posterior flap comprises the cartilage and conjunctiva. The first incision is made near the lachrymal point, just outside of the line of the mouths of the meibomian follicles, and extends to the external angle of the eyelid. The incision is carried to the depth of 1½ to 2 lines. This first step having been completed, an incision is made through the skin and muscle to the surface of the cartilage, parallel to the free margin of the lid, and about a line and a half or two lines from its lower margin. The extremities of this incision extend a little beyond the corresponding extremities of the incision in the margin of the lid. The two wounds are made to communicate, so that the anterior flap is only connected with the rest of the lid by its extremities. A second incision is now made through the skin, higher up on the lid, and connecting the extremities of the first incision through the skin. The skin included by these two incisions is then removed, and the lips of the wound united by five sutures. The vertical diameter of the flap of skin removed is determined by the

conditions present in each case. In appropriate cases Arlt also divides, by a vertical incision, the lower portion of the orbicularis palpebrarum, exposed by the removal of the oval piece of skin.

In addition to the operation of Arlt, I have for six or seven years removed a portion of the muscle, so as to expose the cartilage, and then shaved off the convex and thickened portion of the cartilage down to its free margin. This greatly diminishes the rigidity of the cartilage, and favors its restoration to the normal form. The mobility of the anterior flap and the removal of a portion of the muscle renders this last step comparatively easy.

The danger of sloughing of the anterior flap seems to be very small, since no such complication has arisen in the large number of cases operated on by me in public and private practice. I have had more trouble in cases of simple excision of a flap of skin, but this is of course accidental. The results in a large number of cases are excellent, and until a year past I have adhered to this operation.

About a year since, meeting with three exceptionally bad cases, I determined to *extirpate* the *cartilage instead* of *thinning* it; *after having first taken all* the *steps* in the *operation* as *above described.*

The extirpation of the cartilage is begun by an incision in the posterior flap, along its free margin, between the cartilage and the conjunctiva. The posterior edge of the free margin of the lid having disappeared in the course of the disease, the surface of the free margin of the lid has

become changed by long contact with the eyeball and conjunctival secretions. The cartilage can probably be most easily removed piecemeal. The thickening of the conjunctiva renders the removal of the cartilage much easier. After the completion of the dissection there remains nothing but the upper rim of the cartilage, which must be beveled off from above downward and backward. The upper rim of the cartilage being left, the attachment of the L. P. Superioris is preserved. When the cartilage has been removed, the action of the L. P. Superioris upon the posterior flap is partially suspended, and after the oval opening in the skin and muscle has been closed, the posterior flap falls considerably below the anterior. This will at first seem excessive, but the process of cicatrization and appropriate after-treatment will remedy this seeming danger which is in reality, if properly managed, a great advantage. After uniting the wound in the outer flap, it is well to apply collodion between the sutures.

The wound in the lids should not be closed till all oozing has ceased. Great care should be taken that the lower edge of the outer flap should not unite too early and too high up. This can be regulated by the proper use of adhesive plaster and collodion, and by separating the edges of the wound slightly from time to time during the process of cicatrization.

This operation is very difficult, and should not be attempted except by those much practiced in the surgery of the eyelids.

It may frequently be necessary to precede or accompany the operation by that for Blepharo-phimosis.

The results in the three cases operated upon by this method were highly satisfactory. The healing process seems to be favored by the extirpation of the cartilage. After this operation there is no trouble from hair bulbs having remained attached to the posterior flap. The Entropion is much more perfectly cured than by any other operation. The eyelids are very soft, and the cases are much less liable to subsequent chronic irritation. The removal of the cartilages removes to a great extent the pressure on the eyeballs consequent on the atrophy of the lids.

It might be urged against this operation, that after its performance the eyelashes droop too much, and that the Levator Palpebræ Superioris acts insufficiently upon the inner and outer portions of the lid. These defects can, however, be much lessened by appropriate small operations on the skin which can be made after the Entropion and Trichiasis have been cured. This operative method, by diminishing the action of the L. P. Superioris, would seem to offer special advantages in those cases where the vertical diameter of the lids is very small, the eyes deep-set, and the brows very prominent. It is still more strongly applicable in those cases where the cartilages were originally very rigid, and the lids fitted tightly upon the eyeballs. The cornea seems to improve more decidedly and more rapidly than after any other operation performed under the same conditions.

The cases operated on after this method were between the

ages of ten and fifteen years old. In one case an eye had been lost and the ball had atrophied. The remaining eye was much affected, the upper two-thirds of the cornea being vascular and moderately opaque. The sight of this eye is now almost perfectly normal. A second case had been so blind as to be perfectly helpless for five years before the operation. The corneæ were opaque, softened, and conical. The tendency in this case was more to softening and opacity than to vascularity of the corneæ. The opacity was greatest at the center of the cornea. The conicity of the cornea, though not so regular as in the cases of conical cornea, was yet more so than is usual in cases of inflammatory softening. Both eyes are quite myopic. With the right eye the patient now reads No. 5 of Jaeger's test print, and is still improving. With the left eye she can only read No. 20 ; but this difference is owing to the fact that the necessary operations had not been performed on the lower lid of that eye. These operations have been recently performed, and the eye is improving with great rapidity.

The combination of the extirpation of the cartilages with the operation of Arlt, is proposed, not because it may be absolutely the best, but because it is the only one that has yet been tried by me. In the operation of Arlt, as modified by Prof. *V. Graefe*, the cartilage is better exposed for extirpation. This, of course, makes it better adapted to a regular operative method.

It is possible that the partial extirpation of the cartilages may be the best operation in that class of cases where,

though not greatly reduced in their diameters, the cartilages are much thickened, and the inversion is very decided. In these cases the upper half or two-thirds of the cartilage is but little or not at all thickened, and the change in curvature is confined to the lower part.

TEST-TYPE FOR ASTIGMATISM.

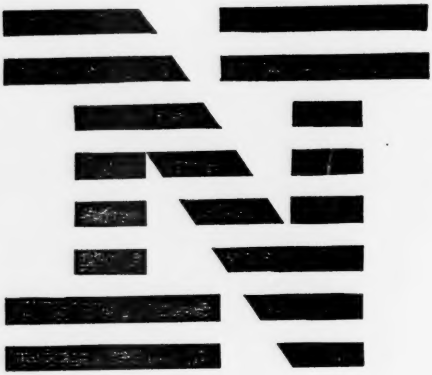
By DR. ORESTES M. PRAY, Brooklyn, New York.

Some time since, while making a small table for testing astigmatism, like those in general use, composed of lines running at different angles, the thought occurred to me that it would be better to make large letters composed of stripes, to be used in the same way as the ordinary astigmatism tables.

Any one who has examined many cases of astigmatism by means of the tests usually employed, has often experienced great difficulty in getting a patient to tell at once which of the different lines or groups of lines appeared most distinct. Great ingenuity has been shown in attempting to overcome this difficulty, but it seemed to me that the striped letters would do so more effectually than any plan yet adopted.

After experimenting for some time, I concluded to make letters three times the size of No. XL. of Snellen, composed of lines, or stripes, just equal in width to the strokes of No. XL.

By making letters half this size, with stripes half as wide,



that is, equal to the strokes of No. XX., a still more delicate test may be obtained.

Twelve letters were chosen, so as to give lines for every fifteen degrees. These letters were N, U, P, E, T, G, Z, O, B, C, D, V, in the order just given, the direction of the stripes being horizontal or 0°, 15°, 30°, 45°, 60°, 75°, 90°, 105°, 120°, 135°, 150°, 165°, respectively, numbering the degrees from left to right through the half-circle.

By putting N, U, P, E, T, G above Z, O, B, C, D, V. those letters, the stripes of which ran at right angles to each other, were placed in pairs, so that the attention of the patient could be easily directed from one letter to the othere

$$\begin{pmatrix} \text{N.} & \text{U.} & \text{P.} & \text{E.} & \text{T.} & \text{G.} \\ \text{Z.} & \text{O.} & \text{B.} & \text{C.} & \text{D.} & \text{V.} \end{pmatrix}$$

The plate shows the first pair of letters.

To give the table a more convenient form, this double row of letters were divided thus:*

N.	U.	P
Z.	O.	B
E.	T.	V.
C.	D.	G.

In employing the test, the patient, with the eyes unde the influence of a sol. atrop. sulph. gr. iv. ad. ℥i, is placed twenty feet from the card, and, of course, each eye examined separately.

When there is so much amblyopia that even with glasses he letters can not be seen easily, it is necessary to bring the patient nearer to the test-table.

Generally, three or four letters will appear darker than

* The full table is to be had through the publishers of these archives.

the rest; but, upon comparing these carefully, the patient will, as a rule, decide that in one of them the black lines and white spaces are more distinct than in the others. If he can not decide between three, I take the middle letter for further experiment. Telling him to fix his attention upon the letter chosen, a trial is made with simple spherical glasses, concave and convex, to see how far, if at all, the clearness of the lines and spaces in the letter can be improved. Noting the result carefully, the patient is then directed to look at the other letter of the pair, that is, the one composed of lines running at right angles to those in the first. The same trial with glasses is made. The results obtained from the examination of the two letters are compared, and so the amount of astigmatism is discovered.

It is best to verify the final result by a trial with cylindrical glasses.

This is the old method of testing astigmatism, as far as the principle is concerned; but it seems to me that the form of test-table I offer facilitates the examination.

Two cases, one of pathological, the other of physiological astigmatism, will better illustrate the practical working of the test-type:

Miss C., æt. 26, under atrop. sulph. gr. iv. ad. ℥i.

R. $S = \frac{20}{200}$. At 15′ saw N blackest without glass. Z blackest with +18. With cyl. +18, axis vertical, $S = \frac{15}{40}$.

L. $S = \frac{20}{20}$. N blackest without glass. Z blackest with +80.

Miss G., æt. 18, under atrop. sulph. gr. iv. ad. ℥i.

R. $S = \frac{20}{40}$. N blackest with +50, Z with +36.

$$As. = \frac{1}{16} - \frac{1}{50} = \frac{1}{128\frac{4}{7}},$$ not worth correcting.

L. $S = \frac{20}{30}$. N blackest with +80, Z with +50.

$$As. = \frac{1}{50} - \frac{1}{80} = \frac{1}{133\frac{1}{3}}.$$

NOTE.—Shortly after the author had handed me, with a good deal of modesty, the MS. of this his first—and unfortunately last—essay, he suddenly perished by a railway accident on Long Island. He was a most talented and amiable young physician, possessing a high degree of knowledge. All who knew him felt with utmost regret, that a life had been destroyed which, preserved, would have had a share in the promotion of science for the benefit of suffering humanity.

H. KNAPP, Ed.

ON A MODIFICATION OF IRIDECTOMY FORCEPS.

By Dr. R. Liebreich, of Paris.

Translated by J. H. and T. R. Pooley, M.D., of New York.

The seizing of the iris presents difficulties in many cases of iridectomy. Although the incisions may have been properly made, and the forceps introduced in the usual manner, either they do not seize the iris at all, or only tear out a small piece of it. There are principally two classes of cases in which this happens. First, in very firm adhesions of the pupillary margin with corneal cicatrices (as after injuries and perforating ulcers), or with very firm secondary cataracts; and secondly, in adhesions of the posterior surface of the iris with the capsule, which are so frequently found after chronic iritis and iridochoroiditis simultaneously with considerable changes in the tissue of the iris. The difficulties which occur in iridectomy have been hitherto explained entirely by these structural changes in the iris, and the lesser resistance which the iris on that account presents.

A more thorough analysis of these cases, however, has

shown me that the same inconveniences may also appear when the resistance of the iris-tissue has suffered very little, or not at all, and that the true reason, common to all cases, is to be found in the extreme tension of the iris. By this the formation of folds is prevented which are an indispensable necessity for the seizure of the iris with the common iridectomy forceps.

The mechanism of the latter is different from that of common forceps, as for instance the fixation forceps. The blades of the fixation forceps are applied vertically to the surface of the membrane which they are intended to seize; the blades of the iris forceps, on the contrary, lie upon the iris and are parallel to it. Therefore the fixation forceps seize by their teeth the two points to which the open forceps are applied, and when they are closed, bring these two points together. In the iris forceps, on the contrary, it is the edges of the blades which glide along the membrane, and form a fold which is only seized by the teeth when it projects between the blades of the forceps.

Generally this folding of the iris is easily brought about, and then the iridectomy forceps are perfectly satisfactory for seizing a sufficient portion of the iris. In those cases, however, in which the iris is tightly stretched by firm adhesions of its pupillary margin or its whole posterior surface, and particularly when its tissue is notably degenerated, the blades of the iris forceps glide over its surface without forming a fold, and the teeth catch nothing at all, or only in the moment of closing the forceps seize a single point of the membrane. Instead of bringing a part of

the iris to the wound, we only pluck a little piece off the membrane.

For such cases I have now had the situation of the teeth of the forceps altered, in such a manner that the surface in which they grasp is turned to a right angle. The teeth indeed are at the front end, but not, as in the common forceps, in a surface perpendicular to the longitudinal axis, but they are concealed in the convex border of the branches, at their front end, so that when the blades lie parallel upon the iris they have the same situation as the teeth of the fixation forceps, in the perpendicular or vertical position of the latter.

The teeth in this manner come into action not only by the closing, but also by the application of the open forceps, and bringing, according as they are more or less widely opened, two more or less distant points of the iris together. The difference in the manner in which the forceps take hold in the difficult cases spoken of, is very great. Besides for the iris, they have done me good service also in the extraction of adherent secondary cataracts.

In reference to the manufacture of the instrument, it needs only to be mentioned, that the teeth, above all things, must on no account project beyond the border of the blades; the forceps must pass as smoothly through the corneal wound as the common iris forceps.

NOTE.—LIEBREICH'S forceps are to be had at
Geo. Tiemann & Co., 67 Chatham Street, and
Otto & Reynders, 64 Chatham Street, New York.

A MODIFICATION OF THE ADVANCEMENT OF THE MUSCLE.

By DR. R. LIEBREICH, of Paris.

Anatomical researches with regard to the capsule of Tennon, and its connection with the muscles of the eye, the conjunctiva, and the caruncle, have induced me for the last four years to modify the operation for strabismus. The following are the results of these investigations:

1. The union of the muscles with Tennon's capsule is a double one. On one side, an annular union of the posterior part of the capsule and its sheath-like processes directed toward the orbit with the belly of the muscles; on the other, a firm adherence of the anterior half of the capsule with the surfaces of the muscles which project into the hollow of the capsule.

2. The conjunctiva is firmly united with the outer surface of Tennon's capsule from the edge of the cornea as far as to an irregular, annular, well-defined boundary line, and in this way it is indirectly in very important relation to the muscles of the eye.

3. The caruncle, together with the plica semilunaris, rests on a ligament which passes from Tennon's capsule to the edge of the orbit. The contraction of the rectus internus, necessitates that by the turning in of the eye this ligament is stretched, and thereby the caruncle which is placed upon it will be drawn toward the inner margin of the orbit. But at the same time also the outer edge of the caruncle, together with the plica semilunaris and a portion of the conjunctiva lying next to and behind it, will be drawn backward and form a fold. This occurs partly because the conjunctiva in the movements of the eye lies to a certain extent close to the globe as far as a certain line, but partly also because the muscle on account of its union with the anterior half of the capsule draws the latter backward in its contractions, where the conjunctiva, plica semilunaris, and caruncle, which are united to it, are obliged to follow.

The procedure to which these anatomical observations have led me, is the following: In the tenotomy of the rectus internus, I raise up with the forceps a fold of the conjunctiva at the lower end of the insertion of the muscle, cut it through with the scissors, pass through the opening between the conjunctiva and the capsule, separate these two membranes carefully as far as the plica semilunaris, and divide the latter likewise as well as the caruncle from the subjacent parts. After having completely freed from the conjunctiva all that part of the capsule which is important for the retraction of the muscle, I separate the insertion of the muscle from the sclerotic in the usual manner, and prolong

at the same time the vertical section of the capsule above and below, the greater the retrocession is to be ; and then I always close the conjunctival wound with a suture.

As the advantages of my proceeding, I have already given notice two years since, first in the "Archiv. fuer Ophthalmologie," of the following :—

1. A greater freedom, and a much greater interval for the graduation and the distribution of the operation for strabismus.

2. The avoiding of the sinking in of the caruncle, and every trace of a scar, which are sometimes left behind in the ordinary tenotomy.

3. The avoidance of more than two operations in the same individual, and also of more than one on the same eye.

It has never entered my mind, as has been erroneously affirmed, to recommend the correction of a high degree of strabismus by a single operation.

After having described this modification of causing retrocession of the muscle more than two years since, I now first communicate an analogous modification of its advancement, for the simple reason that, though I had very soon numerous opportunities to try the proceeding for common tenotomy, the indication for advancement occurs much seldomer. But now I have further been able sufficiently to observe the results of the latter, to feel justified in recommending the following proceeding.

After a broad vertical incision of the conjunctiva in the neighborhood of the insertion of the muscles, or better somewhat behind it, I burrow beneath the conjunctiva with the

scissors, both toward the cornea and the opposite directions so as to separate it completely from the subjacent Tennon's capsule. Afterward I make the tenotomy and cut the capsule above and below, in the direction of the insertion of the muscle, so far that the muscle and the part of the capsule that lies upon it are completely movable, and may easily be brought forward to the border of the cornea. Here I fasten them in the following manner. I pass two fine needles, attached to the two ends of the same thread, above and below, at a distance of about one line from each other; first through the capsule and the end of the muscle, and then from behind forward through the conjunctiva, and tie the loop over the conjunctiva. Of such sutures, or rather loops, I apply at least two, one in the neighborhood of the upper, and the second in the neighborhood of the lower border of the muscle. After the muscle and the capsule are in this manner fixed beneath the conjunctiva close to the edge of the cornea, I carefully unite the conjunctival wound with several sutures. If the attainment of the mechanical design demands the shortening of the muscle, this presents no difficulties; on the contrary, this proceeding favors, when necessary, the removal of a portion of the anterior extremity of the muscle and also of Tennon's capsule.

By the latter procedure, we are able to produce a considerable effect on the prominence and apparent size of the eyeball.

But the advantage of this proceeding lies in this, that we avoid thereby the cutting out of the conjunctiva, which very often leads to essential inconveniences, in particular long re-

maining irritation, tight folds impeding the movements of the eye, &c. In every case it is more rational to spare the conjunctiva, if its excision is not requisite to attain the mechanical effect.

TWO CASES OF EXTRACTION OF A FOREIGN BODY FROM THE CORPUS VITREUM.

By DR. R. BERLIN, in Stuttgart.

The interest Prof. *Knapp* kindly expressed, at the last Ophthalmological Congress at Heidelberg, in my observations about foreign bodies in the corpus vitreum, encourages me to relate the history of two new cases, in which a foreign body has been extracted from the corpus vitreum. The first case shows how important it sometimes may be, for the diagnosis, to know exactly the power by which the foreign body was moved forward. The second case confirms the value of a "limitation of the visual field," found shortly after the wounding of the eye, both for the diagnosis of the presence of the foreign body in general, as well as for the discovery of its position. Besides that, it shows a progress in the method of extraction.

1. A young woman serving in a shooting-gallery for air-guns, had been wounded by the awkwardness of a man, who struck her right eyebrow with the barrel of the charged gun. At the same

moment the gun went off. The girl staggered, but did not fall. Half an hour later vomiting occurred which was repeated twelve times during the same night, alternating with diarrhœa, short attacks of fainting, and giddiness. About 12 hours after the accident I saw the patient for the first time. I found her a strong young woman. She then showed no derangement in her general health, especially no fever and no retardation of the pulse. The eyelids on the right side, and the surrounding parts, were extremely swollen and suggillated. It was very difficult and painful to draw the eyelids apart. When open they showed the conjunctiva greatly swollen around the opaque and somewhat gray cornea. The latter itself was lacerated by a wound having four rays, which met about the center of this membrane. The peripherical ends of the rays reached almost to the border of the sclerotic. The eyeball was collapsed and soft. The sensation of light wholly lost. The grave nervous phenomena which existed, such as fainting, giddiness, and chiefly vomiting, so often repeated, might be reflective symptoms due to the violent concussion of the eyeball, or they might be, in spite of their cessation for the moment, the direct effect of a real wound of the brain. It was therefore now the main question to judge, whether the power of the air-gun was great enough to drive the ball forward into the brain. For this purpose I sent to the owner of the gun, in order to obtain a statement of the charge usually employed. But as he could not give me the information I desired, I tried the same gun myself. We shot against a deal door at a distance of 4 paces. The usual lead ball, which had a diameter of somewhat more than three lines, was thrown back by the soft wood, and only left a superficial mark. By this trial I was convinced that the ball had not force enough to pass twice through the membranes of the eyeball and also to penetrate through the contents of the orbit and its bones. As it was impossible to restore the sight, I now dared to examine the interior of the eye with a button-probe. After some

attempts I found on the bottom of the eyeball a hard object with a smooth surface. It was very easy to catch it with forceps, and, after having enlarged one ray of the wound, to extract a little lead ball of about 3 lines diameter.

After the removal of the ball none of the grave symptoms were repeated. The inflammation of the eye and the swelling of the lids diminished gradually. Eighteen days after the operation the patient was dismissed, of course with a shrunken eyeball, but free from trouble.

2. A smith, employed in a machine manufactory, felt his right eye hurt, whilst he was chiseling cast steel. Immediately after he was wounded, he remarked an obscuration of sight, which increased very quickly. Four hours later I saw the patient. The conjunctiva of the eyeball was moderately inflamed, the cornea had a perpendicular sharp wound more than 3 lines long, which was situated in the upper part and on the outer side of the vertical meridian. The wound reached to the sclerotic. The anterior chamber had disappeared; the eyeball was very soft. The iris and the lens were cut in the same direction as the cornea. The lens was already opaque. When I examined the acuteness of sight in a dark room, I found that a candle, giving a moderate light, was recognized at a distance of about 6 paces. When the candle was quickly moved before the eye, its position was only noticed in the lower half of the field of vision. By this limitation of the eccentric sight it was proved, that the interior parts of the retina did not perceive the light, or that, because of some material obstacle, the rays could not reach the retina. Guided by a large series of anatomical investigations made on eyeballs which were extirpated soon after the entrance of foreign bodies into the corpus vitreum,* I concluded that the limitation of the field of the vision was the effect of

* These observations I published in *Von Graefe's* Archiv. fuer Ophthalmologie, XIII. 1, and XIV. 2.

an extensive hemorrhage in the lower parts of the corpus vitreum.

The origin of these hemorrhages are wounds of the choroid and retina on the posterior wall of the eye, produced under similar circumstances, not by concussion of the eyeball, but by the direct blow from the foreign body. These wounds of the interior membranes always happen, if a foreign body enters wholly within the space of the corpus vitreum. For the force which drives foreign bodies forward through the resistant external walls of the eye is too great to be broken by the resistance of the soft corpus vitreum. The most important symptom, however, for the diagnosis of the entrance of a foreign body into the vitreous, and its sojourn within it, is a limitation in the upper part of the field of vision, found immediately after the injury of an eye. This holds good especially in cases where the wound is small and penetrating, and where the circumstances, under which it happened, make it probable that the wounding body was also small. As to the position of the foreign bodies, heavy ones, which are not fixed in the posterior wall of the eye, are always found on *the bottom of the eyeball.* This position they reach by being repelled from the posterior wall and sinking afterward by their own weight. All those heavy bodies, whose position on the bottom of the eye I had the opportunity of measuring in the anatomical examination of extirpated eyes, were found a *little before the lower part of the equator* of the eyeball. If an abundant hemorrhage was detected, the greatest quantity of blood was found about the foreign body. In the

cases known to me, examined immediately after the accident, in which the body was found fixed in the posterior wall of the eye, an extensive hemorrhage was never observed, and I believe that in such cases there will be little or no limitation of the field of vision. On the other hand this limitation has hitherto always proved to me that the foreign body should be found on the bottom of the eyeball. Guided by this anatomical fact, I found in two recent cases the foreign bodies, whose presence and position I diagnosticated from the limitation of the visual field, by an incision into the sclerotic of the living eye, made between the edge of the cornea and the lower part of the equator. In one of these cases the foreign body could be extracted, but the eyeball shrunk afterwards. It is sufficiently known that the larger wounds of *the sclerotic* are very dangerous, because they very often cause subsequent detachment of the retina by the shrinking of the cicatrix. Therefore it is necessary to choose another part of the eye for the incision and extraction of the foreign body, lest the sight be endangered by the operation itself. Of course the part most capable of supporting a surgical operation, is the junction of the cornea with the sclerotic.

The patient entered my hospital next day, the 13th Aug., 1868, about 24 hours after the accident. The inflammation had increased and the conjunctiva began to grow œdematous; the neighborhood of the corpus ciliare was very sensitive; the acuteness of sight had greatly diminished. By these symptoms it seemed probable to me that a purulent inflammation of the interior membranes was beginning, and that there was no hope of a recovery of sight by

the removal of the foreign body. Without the extraction of the foreign body, the right eye was not only certainly lost, but there was, besides, the danger of sympathetic inflammation of the left eye. Therefore, unless we should have preferred to do nothing, there was only the choice between the extirpation of the eyeball and the trial of extraction of the foreign body. I believed it to be right to let the patient himself decide what should be done, after having carefully informed him of the probable consequences. He preferred the trial of extraction, although I had pointed out that the discovery of the foreign body was by no means certain. The operation was performed in the following manner: First, I made with the small cataract knife of *Von Graefe*, on the lower edge of the cornea, the ordinary cut for extraction of cataract.* This cut was performed a little longer than is usual. Then, after having excised the iris and drawn out the cataract, I entered with the knife into this wound and opened the posterior capsule of the lens and the hyaloid, as far as possible, in the same direction. Having now got a way to the interior of the eyeball, I sought with a probe for the foreign body on the bottom of the eyeball before the lower part of the equator. After several fruitless trials I found a hard resistance at a distance of about 4 lines from the inner edge of the wound made in the corneal margin for the extraction of the lens. After that I was able to seize the object with forceps, and I drew out a small piece of iron 3½ lines long, and about 2 lines broad, which the patient recognized as broken from the edge of his chisel. The next day the chemosis had somewhat increased, and diffuse opacity of the cornea set in. The eye shrunk gradually and without trouble by suppuration of the vitreous. The patient could be dismissed with a moderate eyeball the 6th Sept., *i. e.*, 24 days after the operation.

* *V. Graefe*, too, has of late recommended this section as the most appropriate for the extraction of foreign bodies from the vitreous. Confer. Arch. f. Ophth., XIV., 3, p. 146.

As previously mentioned, I was prepared for this result, which became already more evident, when together with the extraction of the foreign body a little blood and yellow matter came out, which, with the aid of the microscope, I recognized as pus.

In consideration of the unfavorable prognosis of this case in general, and the wish of the patient to have the extraction of the foreign body tried, I thought justified in doing this; imagining at the same time the case would furnish a direct proof of the diagnostic value of the limitation of the visual field, moreover afford a good opportunity to try a new method of extraction, which, of itself, does not absolutely endanger the existence of the eye. The satisfactory result thus obtained has decided me to employ the same method in similar cases which may present themselves to me hereafter.

DISLOCATION OF THE CRYSTALLINE INTO THE CORPUS VITREUM, AND AFTERWARD INTO THE ANTERIOR CHAMBER.—THE EFFECT OF REFRACTION.

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By HENRY D. NOYES, M. D., of New York.

The following case came under my observation at the New York Eye and Ear Infirmary, being brought to my notice by Dr. *Watts*, who had charge of the patient, and who requested me to make such use of it as seemed proper. Accordingly, an account of the interesting facts as regards the refraction of the eye appeared in the *Medical Record* for March 1, 1869, but at that time the clinical history was incomplete. I am able now to give the case in full, and hope that a partial repetition will be justified by the rarity of the observation.

A man, 45 years old, in a drunken brawl, received a blow with the fist on the left eye. About three weeks after it happened, that is, in December, 1868, he came to the Infirmary. He was examined by Dr. Watts who found the crystalline lens to have been dis-

placed directly downward in a vertical plane, and its upper border projected above the rim of the enlarged pupil. A solution of atropia had been put into the eye to facilitate the ophthalmoscopic examination. No other injury was discovered, and the eye was but moderately injected. Sight appeared to be as good as the altered conditions of refraction would admit, but no examination with trial-glasses was made.

About a week after he said that his sight had greatly improved. He was now able to read, which before was not the case. The crystalline was discovered to have come forward into the anterior chamber. This fact was easily known by the way in which the iris was pressed back, and by the brilliant border of the lens where intense reflection of light occurs. The lens had a faint amber tinge appropriate to the age of the person, but was perfectly transparent. It was of course still inclosed in its capsule.

The change of position had been brought about by a vigorous fit of sneezing. On the evening of the last day when he visited the Infirmary, and when atropia had been put into the eye, he took a pinch of "catarrh snuff," and sneezed seven or eight times. Immediately afterward he found his sight improved.

In this novel state of affairs I at once proceeded to ascertain what was the exact effect on the refraction. As the nodal point was very decidedly advanced, the eye, if formerly emmetropic, must now have become myopic.

The interesting point was the degree of myopia. Inasmuch, too, as the lens is in bulk not equal to the capacity of the anterior chamber, and its specific gravity heavier than that of the aqueous humor, its axis does not coincide with the visual axis but lies below it. Hence there must be astigmatism.

The examination was made both by myself and by Dr. Schiff. The good eye was found to have hypermetropia manifesta, 1-18.

The injured eye to have myopia 1-9 and myopi astigmatism 1-24.

The formula for the two eyes are

O. D. Hm. 1-18 V. = 20-40.

O. S. M. 1-9 A' M 1-24 axis 30° (paral.) V. = 20-50.

If we assume that originally both eyes had the same refraction, namely, hyperopia 1-18, which is probably less than would be exhibited with atropia, we find the displacement of the lens with the anterior chamber to be optically equivalent to myopia 1-6.

The results found by trial-glasses were afterward verified by the ophthalmoscope with the upright image, and proved to be in accord.

I am not aware that any similar observation is recorded, and think the fact worthy of note as a contribution to physiological optics.

There was at this time no irritation of the eye. The removal of the lens was hinted at, but the man was unwilling to submit to any operation. It was hoped that trouble might not arise, but the man was warned to return immediately in case of any mischief.

After about a month's absence he returned with the account that after a little while the eye had begun to inflame, that he had suffered intensely, been deprived of sleep, but was dissuaded by his friends from coming sooner to the Infirmary. Now the lens was opaque and the eyeball in a state of complete glaucoma. There was no perception of light—the globe hard and painful on pressure; there was considerable ciliary hyperæmia.

For the sake of rendering the eye quiet it was decided to remove the lens. This was done under chloroform, by means of Graefe's knife. Vitreous escaped during the operation. The reaction which followed was pretty severe, and suppurative iritis ensued. After being in the Infirmary about three weeks he was dismissed.

I saw him on March 20th; the eye now comfortable, scarcely any visible hyperæmia, the cornea hazy, an exudative tissue occupies the pupil and runs across the front of the iris—the globe has normal tension, it bears pressure without exhibiting pain—there is not the least perception of light.

STRICTURE OF THE NASAL DUCT

By E. WILLIAMS, M. D., of Cincinnati.

The literature of lachrymal obstructions forms a long and knotty chapter, in which every new method of treatment proposed, while promising the happy solution, has proved inadequate, and shared the fate of its predecessors.

I was very forcibly struck with this idea when reading the discussion in the Ophthalmological Congress at Paris in 1867, elicited by Mr. *Laurence's* paper on extirpation of the lachrymal gland. The twenty cases of extirpation which he then reported had all been unsuccessfully treated for epiphora by other methods, but mainly by *Bowman's*. He states that the weeping ceases, but the moisture of the eyes remains normal. This extreme and radical measure was severely criticised, but from very different motives, by different members. *Wecker* had happily never been *reduced to the necessity.* Prof. *Arlt* opposed it as unjustifiable in the treatment of diseases of the tear-sac, and not free from danger to life. Besides, he was well satisfied with

Bowman's method, and only in very rare cases failed to obtain his object by this treatment. He had only had recourse three or four times to obliteration of the tear-sac with the hot iron. The Spanish oculists came out in solid phalanx in favor of obliteration, as affording brilliant results, at least in their country, exhorting the doubting Thomases to "come and see." Finally, *Giraud-Teulon* and *Warlomont*, with true French courtesy, insist that it is here a question, not of principles, but much more of two large classes of facts, dependent on differences of climate, or other similar causes. It is undisputed that by the conservative method—that is, by progressive dilatation of the tear passages—a large number of cases are cured; that, however, in other latitudes occlusion also affords capital results.

A warmer climate, especially, might explain the different results as to the remaining epiphora, which is the chief objection urged against obliteration. It is well known that, with most patients, the weeping is much more annoying in winter than in summer.

Judging from the discordant views just alluded to, we infer that the combined wisdom of Europe, represented in the congress, is not yet sufficient to settle the question of the best method of treating strictures of the lachrymal passages. The serious proposition to generalize extirpation of the tear-secreting organ, as a means of combating epiphora, leaving the fons et origo, the suppurative inflammation of the sac, and the stricture to take care of themselves, is, to me at least, rather amusing, when there are so many "ra-

tional and very certain ways of removing the obstruction." It is like chopping the patient's head off to relieve him of the pains of an inverted toe-nail, or costive bowels! The old method of occlusion of the sac is far more rational and free from objection than extirpation of the gland. The former, indeed, is only indicated in bony atresia of the nasal duct with troublesome lachrymal tumor, or in extensive caries of the bones, both of which are extremely rare. Extirpation of the gland is unjustifiable, except as a means of palliating the stillicidium lacrymarum which accompanies incurable ectropium or loss of the eyelids or of the canaliculi. As obliteration of the sac has been recommended on the one hand, and extirpation of the gland on the other, why should we not combine the two and make a sure and a clear thing of the whole difficulty?

My object, however, in writing this paper is not the easy task of finding fault, but to give a succinct statement of my own experience in the premises. As a zealous disciple of the elder *Desmarres*, I practiced occlusion in all bad cases of lachrymal tumors, with or without fistula, for several years. Milder ones were subjected to palliative treatment only. A new era was at length inaugurated by *Bowman*, who happily suggested the natural and easy way of opening the sac through the canaliculi. I then adopted his method, and found that in the immense majority of cases of stricture of the nasal duct, it afforded great relief, and in many a permanent cure. Relapses, however, were frequent, and in some the treatment failed altogether; so that I still had to fall back, now and then, upon occlusion.

Weber's idea of slitting up the upper canaliculus instead of the lower, and of using larger probes and more systematic medication of the diseased mucous membrane by astringent injections, seemed to me an improvement. In repeated trials of his operation, I became convinced that unnecessary injury was thereby done to the tear-sac and mucous membrane; and I found also that relapses were occasionally observed even after long continuance of the treatment.

After a thorough trial of both these methods, I began to consider what might still be done to insure greater success. To adopt a treatment which should combine more certain relief with less suffering and loss of time to the patient, as well as less trouble to the operator, was my object. For more than seven years I have pursued a method that has afforded a much larger percentage of permanent results, with vastly less suffering to the patient and trouble to myself. In the *Cincinnati Lancet and Observer* of November, 1864, I published my first account of the procedure, and five years more have only confirmed my then very favorable experience. *The essential and peculiar feature of the treatment consists in causing the patient to wear the stile constantly during the whole course of treatment, instead of its occasional temporary introduction.* True, Bowman had suggested the wearing of a small wire for a few days at a time, but this I found insufficient.

Warlomont, in the *Supplement to Mackenzie*, describes a case of a young girl whom he made wear a small silver stile for a month after cauterization of the sac with chloride

of antimony. But it was not recommended as a uniform practice. So general was the aversion to the old method of wearing a stile (of whatever material) through the fistulous opening in the skin, that the idea of returning to the same treatment in a modified form was not well received. The failure, as I conceived, and as my experience has demonstrated, did not attach to the use of the stile as a means of dilatation; but to the *artificial opening*, whether through the skin or the conjunctiva, in which it was worn.

The stricture of the ductus ad nasum was no doubt cured in most or all of the cases, but in accomplishing this a worse condition was brought about by the injury done to the sac, and the parts overlying its junction with the nasal duct, by the presence of the stile.

Its contact with the raw edges of the fistula caused inflammation, ulceration, thickening, and subsequent rigid contraction, with, frequently, complete closure of the sac at the commencement of the nasal duct. Thus there was produced a mechanical difficulty in the absorption of the tears, as well as a new obstruction to their passage from the sac downward. It is perfectly clear that the wearing a stile through such an opening, was altogether different from the method which I have introduced. The presence of a smooth silver stile, even of large size, in a natural opening, lined by *mucous membrane*, is tolerated with impunity, and the results are altogether different. The reintroduction of the continuous use of the stile, under more favorable auspices, in the treatment of stricture, is all that I claim.

I had a series of silver stiles made and numbered from 5 to 9, inclusive, of the bougie scale, my *smallest* corresponding to Bowman's largest, and being about one-sixteenth of an inch in thickness, the largest being one-eighth of an inch. They are from one and three-quarters to two inches long, to suit different cases, slightly conical at one end and flattened at the other. I order them straight, and bend them in each case to suit the length of the nasal duct and the peculiar conformation of the inner canthus. I have tried stiles of pure tin, of lead, and of hard rubber, but prefer the soft virgin silver.

I have modified my procedure in several particulars since my first published paper. As before, I slit up the superior canaliculus, but no longer with Weber's knife. A delicate pair of scissors, with one branch probe-pointed and slightly longer than the other, answers the purpose admirably, and is much quicker done and less painful than the knife, for obvious reasons. I do not now cut the sac, but simply slit up the canaliculus down to it, or nearly so. If I there find its inner orifice dilatable I expand it with a conical probe till it will admit Bowman's No. 6. Should the canaliculus be closed near the sac, I guide the point of a cataract knife along the probe and puncture the sac. This done, I at once proceed to explore the sac and duct. For this purpose I use generally a set of probes like Bowman's, except that they terminate by bulbous ends and are much smaller for about half an inch above, so as to yield more easily. These were invented by my friend Dr. *Henry Williams*, of Boston, but I find that *Teale*, of Lon-

don, used exactly the same kind of probes in 1860. (Med. Times and Gaz.) The bulb on the end of the largest, marked 6, is the size of my stile No. 5. They are very *insinuating*, and useful in exploring the tear-passages. After passing one of them, I learn the peculiarities of the canal to be traversed, and can then put Bowman's No. 6 through with greater certainty and assurance. If the stricture is not very tight, I soon coax one of these flexible probes through into the nose, using but very moderate force. In case the resistance is too great to be overcome by these probes or small bougies, or flexible rubber probes, I lay them all aside and force the stricture either with No. 6, or with Weber's bicone, or what is still safer and better, a probe of the following description. It is of silver and double, like Bowman's probes. At each end is a conical enlargement of different sizes, which reaches its greatest thickness at from 3½ to 4 lines from the end, and then diminishes rapidly again to about one-fourth of the size of the expansion. The smallest expansion is about one line in thickness, and the largest one and a half lines. If force must be used to pass the stricture, the larger the probe the less danger there is of making a false passage. The probe just described (I do not remember whose idea it is) is admirably adapted for this purpose. The thick part fills the duct and keeps the conical point in the axis of the canal. With reasonable care to keep the instrument in the direction of the canal; there is no possible risk of piercing the mucous membrane. Besides, it enables us to determine the exact seat and number of the strictures,

which is impossible with a probe of uniform size or gradually increasing all the way, as in Weber's bicone.

Having now entered the nose, I leave the probe a few minutes, and then withdraw it in favor of a stile that I introduce to remain. Before removing it, however, I mark the point that corresponds to the place of junction of the sac and canaliculus, so as to measure off the required length on the stile No. 5, which is now to be bent to fit, and passed in to remain. With a pair of pliers I bend the flattened end so as to make it hook down over the lower lid. A second bend outward, just below the first, makes it fit much better and prevents the lid from dragging the hook round against the eye. This is next passed down and left in, if it fits at all well; if not, it is again withdrawn and bent to better suit the peculiar shape of the canthus. Instead of flattening the upper end, I now generally leave it round and slightly smaller for about half an inch from the end. In most cases the pain, caused by the presence of the stile, passes off or abates very much in a few hours, so as to become endurable. It is a rare thing now to find a patient that will not bear the stile from the very first. Should the pain be excessive and the swelling increase for several hours, in spite of morphine internally and cold water locally, I take it out and try it again the next day or the day after. I always fit the patient with the permanent stile at the first operation, and rarely find that it is not borne as well as later. In 48 hours I usually find the stile so loose that it can easily be withdrawn and the sac washed out with tepid water. If the water passes in a free stream through the

nose, the passage is free, and the stile all right. Should the water not pass at all, or only imperfectly, there is a stricture at the nasal end of the duct and the stile is not long enough. The bulbous probe is now passed down the canal explored anew, and a longer stile adopted. I gen erally pass the stile down till its nasal end rests against the floor of the meatus or almost touching it. Strictures at the nasal outlet of the duct require more care and longer stiles than those higher up in the canal. For washing out the sac, I find the hard rubber dental syringe the best. I have them made with straight, short, conical nozzle to receive a silver point, bent at right angles to be slipped over it and made tight. Of these points I have 3 sizes, the largest of the size of No. 5. In very timid and sensitive patients, I sometimes leave the stile several days, or even a week before taking it out the first time. Indeed, I frequently send the patient home, if he does not reside in the city, and leave it in several weeks, after I am sure it is right, and going to be well tolerated. Where there is much discharge I remove the stile and wash out the sac once a day. When there is little or no secretion, every two or three days will suffice. As soon as No. 5 is quite loose and easy, I put in No. 6, bending it in the same form. When this size is attained, I commence the astringent injections each time, or every second or third day according to the amount of blennorrhœa, passing a few drops through after the water, and then at once reintroducing the stile. The solution I generally employ is 20 grains sulph. cupri to an ounce of water. If the parts are very sensitive and inflamed, I adopt a much weaker solution (2 or 3 grains) in

the commencement, and gradually increase the strength. Nitrate of silver may in some cases be better borne, varying in strength from 10 to 20 grains, according to the indication. These injections, with astringents, form a very important part of the treatment where there is blennorrhœa, with or without dilatation of the sac; and it is often very gratifying to see how rapidly the discharge is controlled by them, and the sac made to contract to its normal size. As the state of the mucous membrane improves, the astringents are to be gradually diminished in frequency and in strength. In three or four weeks usually, No. 7 may be reached, and finally, No. 8, which is to be worn for several weeks or months longer, till all suppuration has ceased, and the sac contracted to its natural capacity. There is much more danger of not wearing the stile long enough than too long. The whole duration of the treatment lasts generally about three months, but it varies very much in different cases. I now rarely use the No. 9. It is very large, heavy, and somewhat disagreeable, as well as difficult to bend suitably. The No. 8, is large enough, especially if it is worn *long enough.*

After the first few days, the stile causes no special inconvenience, and the patient can pursue his usual avocation. By selecting a stile of the right length, and bending it nicely, it can be so closely adapted to the corner of the eye as to attract but little attention. Instead of refusing to wear stiles the patients are often reluctant to leave them off, finding so much comfort from their use. In a few cases the contact of the stile produces little fungous growths at the

opening in the sac, which can be readily snipped off. Rarely, when the outward bend, below the hook, is not sufficient, the sides of the slit-up canaliculus grow together external to the stile; but this has no special disadvantage. The stile should always fit comfortably so as not to drag on the lids, and be perfectly smooth.

The advantages of this method over Bowman's, and all others, in my experience, are many. In the first place, it effects a larger percentage of complete cures. All are greatly and permanently benefited, and the immense majority completely relieved. Of the hundreds of cases which I have thus treated in the past seven years, I do not remember more than five or six that have not been entirely relieved; and even their condition is far better than before the treatment, troublesome epiphora being now the only inconvenience, no serious inflammation, no abscesses, and but little mucous secretion. Many patients complain simply of watery eyes while they retain the stiles; but the epiphora nearly always ceases in a few weeks, or at most months, after leaving them off. Of all the cases treated, I have found it impossible to get through the nasal duct in but two, and one of them was a case of long obstruction following fracture of the ossa nasi. I believe with Prof. *Arlt*, that complete obliteration of the nasal duct is extremely rare. Another superiority of this treatment is that it is far less painful to the patient to wear the stile than to have it introduced occasionally, for half an hour, as practiced by others. Each introduction is painful; the patient thus becomes *demoralized*, and is apt to cease attendance too soon, especially as he

must lose half an hour each time in waiting to have it taken out. When the stile is worn, all the hurting is at the start, *when people expect to be hurt*, and will bear it. Another important consideration is, that, in a couple or three weeks, the patient can easily take out and put in his own stile, and use the injections, thus saving much time and expense. After reaching No. 6, I often let them go home for a few weeks, supplying them, of course, with a syringe, medicine, and the proper directions. When convenient, they *come back*, have a larger No. put in and again return home. So little trouble do I have after the first few days, that even children of four or five years allow the stiles to be changed and the injections practiced at pleasure.

In view of the fact that I treat all my cases by this method, in many of them both sacs having to be treated simultaneously, and that I have had the usual number of the worst complications in the worst class of subjects, I know that my results are far better than any I have seen or read of in the experience of others. That dilatation, as practiced both by Bowman & Weber, does not afford results uniformly satisfactory, is quite evident from the recorded statements of many writers, and the recent serious proposition of extirpating the gland, or of obliterating the sac, as in times of yore, as a common treatment for epiphora from stricture of the ductus ad nasum. Certainly the occasional passage of even a small probe through a stricture, and the use of injections often affords permanent relief, and nearly always temporary amelioration. Still the success is not nearly so prompt and permanent as may be obtained by the modifi-

cations which I have described. Although once addicted to it, I have not obliterated a tear-sac for the past seven years, nor found it necessary to remove the lachrymal gland in but one case where both canaliculi were incurably closed. In that instance the success in relieving the epiphora was perfect. The extirpation was performed by my nephew Dr. A. D. Williams, who has recently published the history of the case. A few minutes after the operation, I put a drop of vinum opii in each eye. While the one quickly filled and overflowed with tears, the other remained comparatively dry, and only ran a drop or two after some minutes. While I admit that extirpation of the gland greatly ameliorates the condition of a patient with obstructed tear ducts; it is certainly unnecessarily severe when there is a rational and very sure way of removing the obstruction. I do not claim invariable success for my method, but only a much larger proportion of perfect and permanent cures than can be attained by any other known to me. The large probes, the bougies, the laminaria digitata, &c., are useful in certain cases, but not so generally successful because they are used on the principle of *occasional periodical dilatation*, instead of being *constantly worn* till the cure is accomplished.

The appearance within the past year of *Stilling's* monograph on division of the stricture, and more recently of an article in the *Annales d'Oculistique*, by *Warlomont*, detailing twenty successful cases by the same method; as well as the earlier experience of *E. Jaesche* of Moscow, in very much the *same treatment*, leads us to hope for still further

improvement in the methods of treating this proverbially troublesome disease. *Stilling's* method consists essentially in slitting up the canaliculus, passing a small grooved director down to or through the stricture, if possible, and then passing a suitable knife down through and incising it freely in three or four different directions, so as to make the canal perfectly free. No probes or stiles are to be used afterward, indeed little if any further treatment. In the cases reported by Warlomont, no other treatment was instituted. If the immediate improvement effected by this operation proves to be permanent, it is certainly a great abridgment and simplification of the therapeutics of stricture and its complications. While I sincerely hope it may prove as valuable as its sanguine advocates allege, I must suspend judgment till it is tested by a larger and longer experience. We have recently tried it in four patients. In these we operated according to Warlomont, first passing the bicone of Weber to make way for the knife, and then making free incisions in several different directions.

In one I used a knife of the dimensions of Stilling's, but with a narrower and slightly blunt point. I passed it through the upper punctum down into the sac, and directly on through the stricture, incising the canaliculus and stricture by one continuous operation. A large sound was then introduced, and the whole canal found perfectly free. In this patient the sac was dilated to the size of a large filbert and filled with muco-pus. There was rapid and great improvement, and already in six weeks' time the patient considers himself cured. No treatment but the operation was used. The sac is still very slightly dilated, but has ceased to suppurate, and the epiphora is gradually diminishing. Of course, the final result can

not yet be determined, but the case is very promising. Of the other three one is a scrofulous woman with caries of the bone at the lower end of the duct, that I had treated for months with my stiles and injections. Twice, relapses of suppuration and pain took place after suspending the use of the stiles. I then resolved to try incisions. In the first operation the knife was not long enough to reach the lower and worst stricture at the outlet in the nose. The mattering ceased, however, and the patient improved for a week. Then the suppuration and swelling returned, and I made a more thorough division of both strictures, passing the knife freely into the nose, as well as a large probe. Immediate and great relief followed, so that in two weeks from the second operation the patient went home thinking herself cured. To-day, however, just one month after the operation, I received a letter from her, stating that the suppuration has returned and she is suffering pain in the nose.

Another was in a young man of strumous diathesis, and the victim of chronic trachoma, ectropium of the lower lid, and free suppuration in the sac. The incision was made very thorough, and the canal is still free, as proved by the occasional exploration since, with an elastic bougie. It is now five weeks since the operation, and matter can still be pressed from the sac each day, as he comes for the local treatment of the trachoma. I fear he also has caries of the bony canal. It is but just to say that these two were both very unpromising for any treatment. In the only two fair cases, the result is so far extraordinary, while the other, an incysted lachrymal tumor, was operated only to-day.

In concluding my paper, I wish to give a summary of two rare affections, in connection with the lachrymal apparatus, that have recently come under my observation. The *first was periodical epiphora, due to paresis of the fibers of the obicularis which cover the lower tarsus.*

The patient was a young lawyer, in perfect health, and free from all inflammation about the eye or the lids. During the warm weather of last summer he began to be annoyed by a weeping of his left eye, which came on once in three or four days, lasting for a few hours, and then passing off entirely. When he consulted me it had already lasted for several months. In walking or riding, it would often come on him suddenly, and cause him great inconvenience for perhaps half a day, and then disappear as suddenly as it came. On examination, I found no obstacle whatever in the tear-passages, nor indeed any thing else to account for the strange phenomenon. Finally, I suspected paresis of the orbicularis, and on careful examination I found that by drawing down the lower lid and holding it for a few seconds, it did not so quickly adapt itself to the eye again as on the other side. Judging this to be the only possible cause, I applied a mild galvanic current for half a minute to the lower lid. The epiphora at once ceased for 24 hours, when it recurred, and was again instantly stopped by the same application. After the third application the intervals between the paroxysms of weeping became longer and longer. I directed him to come and have the current used whenever the epiphora returned, which he did, till, in the course of some six weeks, it ceased entirely, and has not troubled him since.

The facts in the case are interesting, as showing the action of the *inferior palpebral portion* of the orbicularis on the absorption of the tears, and the prompt and permanent cure effected by electricity. Why the paresis should have affected that one limited portion of one muscle alone, I do not comprehend. This fact, like many others, can be made to confirm each one of three or four different and even antagonistic theories, of the absorption and conduc-

tion of the tears. So I turn it over, with my compliments to *Henke, Arlt, Stellwag*, and *A. Weber!*

Another case, which I consider almost or quite unique, is that of a *dacryolith in one of the excretory ducts of the lachrymal gland.*

The history is briefly this: a delicate girl 6½ years old, began suddenly to complain of an uneasy rubbing feeling under her upper eyelid. No cause for it could be discovered for some time, but the mother at last on raising the upper lid and causing the child to look down to the floor, saw a little lump on the upper and outer part of the eyeball. The patient was brought to us on the 23d of February just past. On inspection I saw a whitish prominent body, about the size of a small grain of wheat, under the conjunctiva scleroticae at the upper and outer part near the cul de sac. To the touch it was very hard and freely movable under the conjunctiva. Just external to it, and at the bottom of the cul de sac, was a slightly hypertrophied portion of the palpebral division of the lachrymal gland. Directing the little patient, who was very sensible, to turn the eye far downward and inward, I pinched up the conjunctiva over the little tumor, snipped it with the scissors, and then seizing the mass with the forceps, easily removed it with the scissors. It was hard as marble, white, almost transparent, and in the shape of a hemisphere, the flat side resting against the sclerotic. It was closely invested by a thin but firm membrane, which I took to be a portion of duct much dilated. That it is a concretion in an excretory duct deposited from the tears, I think, can not be doubted. By measurement the concretion is 5 millimeters long, 3 wide, and 2 in thickness, weighing one-third of a grain.

The only cases of supposed concretions in the excretory ducts of the lachrymal gland, which I can find reported by

authors, are three in number. Two of these were in *young girls*, where large numbers of hard, chalk-like particles were removed from the cul de sac of the conjunctiva. It is by no means certain that they were not put in the eyes by the patients, to excite sympathy and surprise. I once saw a young lady with caries of the orbita, who repeatedly introduced pieces of wood and fat meat into the eye, which were afterward removed from beneath the lower lid, where they excited most violent inflammation. I extracted a piece of match, and a morsel of fat pork from the eye myself. Up to that time the friends were dreadfully exercised as to whence these foreign bodies came! In the other case of a soldier reported by Laugier in Mackenzie's work, it may have been a concretion in a meibomean follicle. Be this as it may, the novelty of this case will, I hope, be a sufficient apology for its introduction here. Calculous formations in the canaliculi and sac are not very infrequent, but I apprehend that such formations in the excretory ducts of the gland must be excessively rare.

TWO CASES OF INFLAMMATION OF THE TYMPANUM, WITH DEVELOPMENT OF POLYPUS; ONE ENDING FATALLY.

By JAMES HINTON, M. R. C. S.,

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I TRUST that the two following cases will not be without interest. The first exhibits the history of an ultimately fatal disease of the tympanum, as it was observed at intervals for some years before any threatening symptoms set in. Though post mortem details are wanting, yet the general character of the cause of death does not admit of doubt, and it is possible that the practiced eye may discern in my report indications of the serious character of the disease which at the time escaped my observation. At any rate, such were some of the previous symptoms, and such the final issue.

The second case was a striking instance of immediate and permanent relief given to very distressing symptoms of local and general irritation, and the renewal of polypoid growths, and the evacuation of retained discharge from behind them. I am induced to place the two cases together, possibly from a feeling that they constitute a natural contrast.

Case I.—*Chronic Disease of Right Tympanum, ascribed to a blow in childhood; repeated formation of polypus; death, with symptoms of extension of disease to the brain.*

W. L., æt. 35, of healthy constitution but intemperate habits, consulted me on Dec. 5th, 1864. Had been subject to attacks of severe pain and distress with discharge in the right ear since the age of eleven. The cause he believed to have been frequent boxing of the ears. Until three or four weeks ago the left ear had been fairly good; but at that time pain came on in it more severe than ever it had been in the right. Four years, and again two years previously, he had consulted Mr. Toynbee, who said there was a polypus in the right ear.

Since the affection which proved fatal arose in connection with the right ear, I may merely say, respecting the left, that a fibro-cellular polypus developed itself at the roof of the meatus, close to the membrane, which was thick but not perforated. Repeated inflation of the ear improved the hearing, the polypus was removed, and a lotion of Tinct. Iodin. (♏xx — ℥ i) employed, followed by astringents. Alum was applied to the throat and tonics given. The growth entirely disappeared and the membrane became natural; but the meatus remained prone to become irritable at times, and to secrete an excess of epidermis. Otherwise, the condition of the left ear continued satisfactory, with the exception of occasional and easily removed Eustachian obstruction.

The *right* membrana tympani was white, concave, and of a rigid look. There was a slight discharge from the meatus. A loud voice only heard. On blowing air into the nostril, while the patient swallowed, it entered the tympanum with a loud click, and the hearing greatly improved. (Watch, six inches.) Throat red and tumid, tonsils swollen.

Gargle of alum and ginger. Ung. Hydr. and pot. iod. around the ears.

The tympanum was again inflated, with slight improvement on the 6th and 8th, after which he was himself able to force in air. M. T. of a slight pinkish hue and less concave. A little discharge continued. The tuning fork placed on the head was heard pretty well; closing the meatus increased the sound. After a Turkish bath on the 10th, the hearing was worse again, and there was some resistance to the inflation of the tympanum, which was also less effective than before. On the 14th, after a crack in the ear, the hearing improved for a time. On the 16th the Eustachian catheter was passed; the air entered with a dry, rough sound, improving the hearing to five inches. The patient now went to Normandy. In June, after an offensive discharge for about a month, for which a lotion of permanganate of potash was used, a firm, fleshy mass, about the size of a pea, was syringed from the right ear. The discharge ceased for a month, and then soon disappeared again, under treatment by mineral acids and purgatives and a lotion of chlorate of potash and opium.

After six months (Feb. 28, 1866) I again saw the patient. The ears had been quite well and the hearing good ("almost too good," he said), until about 14 days. Then, without apparent cause, the left ear began to discharge, and the hearing on both sides became dull. Watch, each side, contact. In each meatus, at the internal part, there was some hypertrophy of the bony walls. The right membrane presented a pale red surface, of irregular aspect, in which the malleus could scarcely be distinguished. (Congestion and swelling, apparently, of the dermoid layer.) Inflation raised the hearing to six inches. After a month the hearing continued good; no discharge; the membrane had a dry, flat appearance, Eustachian tube pervious.

Shortly after he had a severe attack of delirium tremens; after

which, by his wife's account, he became quite temperate in his habits. He continued, however, to smoke about twelve cigars a day. I did not see him again for upward of two years, June 6th, 1868. The left ear was then fairly well, but he had had a little pain in the right at times. I found a fat, fleshy growth filling the bottom of the meatus, and a little pus escaped when the probe was introduced beneath it. It was touched with tinc. chlor. Air introduced by the Eustachian catheter passed, but not freely, *through* the membrane. Accordingly a few drops of a solution of pot. bicarb. (gr. vj—℥i) were syringed through the catheter with the view of facilitating the escape of matter. Liq. plumbi ʒij aq. ℥i to be applied warm to the right ear; powdered alum mixed with sugar to be blown into the fauces by means of a curved tube. I had from the first warned the patient's friends, that with his habits the disease of the ear might at any time become of a serious character, but at this time I detected no specially threatening symptom. He did not remain under my care, and the next information I received was that he had died ten weeks later (August 12th). On July 2d, he went to Dunkirk, still suffering from occasional pain in the ear, but seeming, in his wife's opinion, no way worse. At the end of the month (about three weeks before his death), he was exposed to a very hot sun, and complained of great pain in the head. He had looked ill a few days before, and had suffered increased pain in the ear after going into the sun or after smoking, but had never before spoken of pain in the head. He was at first treated for brain fever; leeches were afterward applied to the ear. No swelling over the mastoid process or elsewhere was observed by his wife. About three days before his death the discharge from the ear entirely ceased, and for the last two hours matter ran from the right nostril. He was not convulsed nor paralyzed. No post mortem was made.

Case II.—*Inflammation of Tympanam, with formation of Polypi following scarlatina at twelve, and continuing forty years; frequent severe pains in the head, removal of Polypus and retained secretion; entire relief.*

W. I. B., æt. 52, a healthy man, consulted me on 26th March, 1867. Ever since scarlatina at age of twelve, had been subject to occasional discharge from both ears, with deafness, generally not severe, but at times much aggravated. In the left side there was a constant sense of discomfort, and the attacks of discharge were generally attended with pain in the ear and at the back of the head, which had lately become more severe. He could sometimes pass air *through* each tympanum. No tinnitus. A polypus had been long discovered in the left ear, but his medical attendant had declined to remove it, fearing lest irritation of the brain should ensue. On right side, watch heard on contact; left, a loud crack of the nail at three inches.

Right. M. T. red at the upper part; inferiorly it seemed thinned in patches, and a little below the center was a small orifice, about half a line in diameter. No discharge. Passing air through the Eustachian tube improved the hearing slightly. The left meatus was filled with a polypoid mass, which on examination appeared to consist of five, more or less, distinct growths. Of these, four were removed; one, which protruded nearly to the orifice, was of a bright red color, and had its origin from the floor of the meatus; and three others, of smaller size, which evidently grew from the internal wall of the tympanum. There was a fifth, but this was not touched. After the removal of the growths, a dirty white surface was exposed. This consisted of masses of inspissated discharge, several of which were removed by the syringe, aided by inflation of the ear—air passing very freely through the Eustachian tube. In fact, the tympanic cavity appeared to have been filled with this kind of

matter. After its removal, the watch was heard at half an inch. A blister was applied behind the ear and the exposed surface of the tympanum was cleansed and dried and dressed daily, for a week, with powdered talc to which a little morphia had been added. It rapidly assumed a dry and healthy appearance and the remaining polypus shriveled up. Immediately after the removal of the polypi the irritation abated; it soon ceased entirely and has not returned. The hearing continues (after 18 months) fairly good; the Eustachian tube is freely pervious, and the exposed surface, though tumid and of dark red color, is entirely free from discharge or tenderness. No vestige of membrane or ossicula is visible. Soon after the removal of the polypi from the left ear the *right* ear took on a slight attack of inflammation, and was for some days very tender and painful; the meatus being swollen and the Eustachian tube closed. This attack soon abated; and by the aid of lotions of sulphate of zinc, or borax, and opium, with alum to the throat, the hearing has improved; but the left has been the better ear.

EMBOLISM OF A BRANCH OF THE RETINAL ARTERY WITH HEMORRHAGIC INFARETUS IN THE RETINA.

By H. KNAPP.

About fifteen years ago the genius of Prof. *Virchow* predicted that, with the ophthalmoscope, embolism in the retinal artery might be directly seen in the living body. This suggestion was a fruit of his brilliant discoveries of the varied series of morbid changes, resulting from the obstruction of blood-vessels by thrombosis and embolism. Four years later, in 1858, Prof. *V. Graefe* observed the first case in which almost instantaneous blindness was caused by obstruction of the central retinal artery, ın a patient suffering from indocarditis. Since that time several cases of this kind have been described, in all of which the symptoms observed tend to the supposition of an embolus, located *within the central retinal artery before its entrance into the eyeball.* Two cases only are on record where the obstruction took place *within the eye*, and was limited to one of the branches of the retinal artery. The first is that published by Prof. *Sæmish*, of Bonn, in *Zehender's Klinishe Monatsblaetter*, 1866,

p. 35, and accompanied by a chromo-lithograph, representing [in the inverted image] the blood-vessels in the upper half of the retina, and upon the optic disc as being in a normal state; the inferior principal branch of the retinal artery, however, displays a slight intumescence beginning just at the margin of the optic papilla, and extending thence about half the length of the diameter of the optic disc. From this point to the periphery of the retina, the artery appears as a thin white thread, and nearly the entire lower half of the retina itself has lost its transparence, and assumed a milky white tint. The field of vision was correspondingly curtailed, whilst the acuteness of direct sight and of that in the other parts of the visual field proved normal. The patient had noticed the defect two days before, and his habit to use this eye for taking aim with his gun is a proof that the defect did not exist previously. His general health was perfect, and the most careful examination could not detect any irregularity in his organs of circulation, in particular. The opacity of the retina disappeared very soon, but the state of the artery and the defect in the visual field proved stationary.

The second case is observed and reported by Dr. *Hirshmann* in *Zehender's Klin. Mon.*, 1866, p. 37. A patient with cardiac disease and articular rheumatism had, six months ago, noticed, when stooping, a sudden obscuration of his visual field. His sight had improved, but was still impaired ($S = \frac{1}{4}$). The lower part of the field of vision was failing as far up as a line of five centimeters below the point of fixation, the latter being one foot distant from the eye. The upper branch of the central retinal artery

had its normal width only in a short portion which lay nearest to the point of its entrance into the globe; its first divisions beginning at the optic disc, were extremely small, thread-like. Toward the equator of the globe, however, they grow thicker. The veins, the optic papilla, and the whole fundus of the eye displayed no other abnormity. The patient remained under observation for some time, had three times Heurteloup's leech applied, without producing any effect upon the visual field or the alterations of the retinal vessels, but the acuteness of direct vision improved from $\frac{1}{4}$ to $\frac{2}{3}$ of the normal.

To these two cases, I can add the following *remarkable observation of my own.* A case which I published in the Arch. fur Ophthal., XIV., 1, p. 217, as partial embolia was not considered by me to be an embolism of one branch, as Mauthner quotes it, but to be an incomplete obstruction of the trunk of the central retinal artery, the obstruction of the upper branch being more thorough than that of the lower.

Mrs. F. from Mannheim, aged 37, had since her last delivery, six years ago, been subject to repeated spasmodic attacks in her abdomen, pains in the region of the heart, irregular action and palpitations of the latter, combined with fever and pains in different places of the left side of her body, in particular hemicrania. All the time she would have painful swellings in her neck, lasting for twenty-four hours, bloody evacuations of her bowels, and pains in making urine, which, though being albuminous for some time, was always free from sugar. For these and part of the following particulars, I am indebted to the kindness of her family physician, Dr. *Stehberger.* What afflicted the patient most, were oppressions of the chest, which, setting in quite unexpectedly, would last from one to five

days, and bring on coughing, especially when a deep breath was taken.

Five months ago she had severe pains in the region of the heart, spleen, and stomach; pulse one hundred and twenty; increase of temperature, cardiac sounds impure, urine albuminous. Dr. *Stehberger* diagnosticated peri- and endo-carditis. This lasted at its height during nine days, then the symptoms abated, but aggravated again periodically. *The patient's power of sight* had been perfect until three weeks ago, when she, while reading, noticed that a *haziness was spreading over her book;* she tried in vain to wipe it away. Closing the left eye she found that the right had preserved its normal good sight; but on closing the right eye she could not see distinctly with the left, and every thing she tried to catch with the latter alone, appeared to be at a greater distance than usual. When she presented herself to me on the 20th of Feb., 1868, she stated that no change had taken place in the condition of her eye since she first noticed the disorder three weeks ago. I found the outward appearance, motion, and tension of both eyes normal, $S = 1$ in the right, but $= \frac{1}{3}$ in the left, by direct vision. The visual field had a *defect* which corresponded pretty accurately with the inner and lower quadrant, so that in this space neither the hand nor a candle was perceived. The apex of this triangular defect was directed toward the point of fixation without reaching it entirely, but lying from one to two decimeters beneath it. The limits of the defect were not sharply defined lines, but formed a small band of about one centimeter in breadth, in which the perception was only diminished. Vision in the remaining parts of the visual field was good.

The ophthalmoscopic conditions of the fundus of the eye are represented in Fig. 1, Plate A. They are drawn from the inverted image, and I shall describe them such as they appear. The reader will, therefore, please to remember that the directions are opposite, for

instance, the changes in the lower inner quadrant of the drawing are in reality those of the outer upper one, etc.

The optic disc was normal in the two upper thirds of its area, the center being whiter than the periphery, as usual. The principal branches of the central artery had normal width at their origin, and the upper branch remained so throughout its entire course, but the *lower was abruptly hidden from view* midway between the center of the optic papilla and its margin, *by a reddish gray opacity*, beyond which the retinal veins emerged in normal size; *but the arteries* showed most remarkable alterations. The principal branch, directed downward and inward, appeared extremely thin, like a fine red thread that could be seen distinctly only by a very accurate adaptation with the ophthalmoscope; this is continued for a distance about equal to the length of the optic disc's diameter; then it abruptly enlarged to about two-thirds the caliber of its corresponding branch in the superior part of the retina, obtained a double outline, pursued its regular course toward the periphery, dividing in secondary and tertiary twigs, just as in an healthy eye.

At the outer lower part of the optic papilla *the beginning of blood-vessels was distinguished by a short oblong swelling of a dark red color*, out of which came forth several finer branches that manifested themselves as arteries, by their light red color. Showing no abnormality in size or direction, they evidently must have conveyed arterial blood in a regular current.

By pressing with my finger upon the eyeball, I could produce pulsation in the upper division of the central retinal artery, but not in the lower. The fundus oculi, with regard to its vessels and other details, proved normal in both the upper and the outer lower quadrants, but the inner lower displayed very conspicuous alterations. The veins which were directed toward the yellow spot, and all those lying between the horizontal meridian and the principal lower venous trunk, *were enlarged and tortuous.* Most remarkable it was

that the *course of some of them could not be traced to the optic disc*, and only two very small communications between them and other veins were to be distinguished. *Numerous apoplectic spots* of smaller and larger sizes were scattered all over this triangular space, extending from the yellow spot in the apex toward the periphery, as far as the ophthalmoscope could bring it to view, its boundaries being the horizontal meridian and the principal inferior venous branch. Most of the hemorrhages lay around small venous twigs on both sides of the larger branches. Some formed broad patches in which immersed one or several smaller veins. The *retinal tissue had lost its transparency in the whole of this triangular space, showing a reddish yellow opacity.* The yellow spot was very distinctly visible. The retina around it resembled a semi-transparent grayish veil. *All the venous twigs descending from the superior half of the retina* were likewise enlarged and tortuous, but became normal in size and direction at some distance above the horizontal meridian of the retina.

The branches of the *main inferior artery*, that which was narrowed at its beginning, ran in a normal course through the whole region where hemorrhages existed, without giving rise to any extravasation.

The examination of the heart revealed a considerable increase of its size, and irregularities in the valves; the beat of the heart was most distinctly felt one inch and a half outward from the nipple; and in this place, also, percussion brought out a dull sound. The dullness preserved its usual limits upward, but inward and downward it slightly exceeded its normal extent. The sounds of the heart were impure, but no definite murmurs to be perceived.

The *treatment* was a general one, especially directed against the disease of the heart. The patient remained under my observation till October, 1868, that is to say, for eight months. During the first weeks there was no change in the eye recognizable with the ophthalmoscope,

but then a gradual absorption of the hemorrhages took place. They grew paler, first at their border, and disappeared without assuming any other color. I may especially mention that no white specks appeared upon or near the hemorrhagic patches, as is not infrequently seen during the period of absorption in other kinds of retinal hemorrhage. At my last inspection there was only one faint red spot to be observed, all others having disappeared. The retinal tissue, however, had not regained its natural transparency, but was like a tender whitish-gray veil. The arteries were in entirely the same condition as on the first examination, but the *veins of the retina had materially altered.* They were less tortuous and dilated, but not yet of normal size, least of all that branch directed toward the yellow spot. The ramifications which ran through the largest extravasations were still dilated, but less so than formerly, and their courses could be traced to the larger trunks in the direction of the optic nerve. *The acuteness of direct vision had improved to nearly the normal state, but the defect of the visual field had not changed in the slightest degree.*

CRITICAL REMARKS ON THIS CASE.

The diagnosis of endo- and peri-carditis, with subsequent increase of the heart, can not be doubted. The pains and disturbances in different parts of the body are to be explained by the supposition of embolisms in the smaller vessels of these organs; I mention in partic lar the left-sided headache, painful swellings in the neck, bloody evacuations of the bowels, and albuminous and bloody urine, *all of them* being well-known symptoms of embolism in the brain, the cutis or muscles of the neck, the intestines, and kidneys. I must abstain from entering more minutely here upon these interesting subjects, but refer the

reader who wishes to obtain deeper knowledge of them, to the classical researches of *Virchow*, published in his "*Gesammelte Abhandlungen*" and his "*Archives for Pathological Anatomy*," where also a good many valuable articles on the same subject, by other investigators, may be found. A complete description of embolic diseases is contained in *B. Cohn's* book, entitled, "*Klinik der Embolishen Gefässkrankheiten*, Breslau, 1860."

It is somewhat reluctantly that I indicated those references, the reliability of which has been demonstrated by numberless post-mortem autopsies, and is acknowledged by the most eminent pathologists and physicians.

Nevertheless, there has been much controversy about the origin of those characteristic changes, now known as being caused by thrombosis and embolism. In the department of eye diseases, in particular, this controversy is continued by some of the latest and most meritorious authors.

The complex of symptoms so characteristic in appearance, from its almost instantaneous commencement to the ultimate state of atrophy of the optic nerve, first described by *V. Graefe* as embolism of the central *retinal artery*, has been taken by *Fano* (Gazette des Hôpitaux, 1864, p. 482, and Annales d'Oculistique, t. 52, p. 239) and *Steffan* (Arch. f. Ophthalmologie, XII., 1, p. 34–65) for an *obstruction of the ophthalmic artery*.

The reasoning of the latter observer is as follows: "Since an abundant communication between the ciliary arteries and those of the optic nerve and the adjoining retina has been anatomically demonstrated, an obstruction limited to

the central retinal artery can cause a derangement in the circulation of the retina for a period only not exceeding twenty-four hours."

This assertion is not at all conclusive. We know that the collateral circulation in other parts of the body is not always so soon and sometimes never established in a degree sufficient for the integrity of the organ. The retina, in particular, requires an uninterrupted and abundant supply of blood, as is proved by the well-known experiment of *Donders*. When we exert but a moderate pressure upon the eyeball, so as to stop the circulation of the central retinal artery, then our sight immediately darkens, and is suspended until the impediment of arterial circulation is withdrawn. Nobody has ever explained the suspension of vision in this experiment as being produced by the bruising of the nervous substance in the retina, the consequences of which would certainly not disappear so quickly.

Moreover, I am able to demonstrate by this very experiment of *Donders* that, in cases of embolism, the impediment in the retinal circulation will last much longer than twenty-four hours. In the ophthalmoscopic courses I used to give at Heidelberg for the last seven or eight years, I first made the students thoroughly acquainted with all the phenomena of the healthy eye. With regard to this I engaged them to study the visible signs of circulation in the retina produced by pressing with their fingers on the eyeball. In this way I practiced that experiment a good many times on the healthy eye, and less often on eyes affected with various diseases; for instance, chronic glaucoma, in

the first stage of which disease such a pressing is very serviceable to ascertain the diagnosis, as everybody knows. I must confess, in contradiction to *Mauthner*, that I came across no eye in which I could not produce pulsation of the retinal artery, by a pressure so gentle that no individual complained of it. In such eyes only *whose retinal artery was obstructed by embolism or injury, I never could produce a visible beating of the retinal arteries during the first week.* As a rule, it was not before the end of the second week that pulsation could again be seen by applying pressure to the globe; and at this time, too, the caliber of the retinal vessels had regained half or two-thirds of its normal size. (See the observations I published on this subject in the Archiv f. Ophthalmologie, XIV., p. 209, etc., Cases I. to V.) The explanation of these conditions is this. As in all eyes pressure on the globe produces visible beating of the retinal arteries, the obstruction of the arteries only can frustrate the experiment; consequently, such obstruction may be safely assumed as existing whenever pressure on the globe fails to produce pulsation. I think this is plain enough, and I am therefore not a little surprised to find in *Mauthner's* valuable Text-book on Ophthalmoscopy the following passage (p. 345): "If *H. Knapp*, by pressing on an eye affected with embolism, could perceive no change in the conditions of either arteries or veins, it is impossible to draw any conclusion as to the manner of circulation from this unintelligible fact." I may here mention that I saw the veins, in cases of total obstruction of the central retinal artery, unchanged on external pressure, and this is natural

enough. When the retinal circulation is arrested, no blood will enter through the artery, and none flow out through the vein. Pressure on the globe, therefore, can not stop or slacken the exit of venous blood, and cause swelling of the retinal veins, as in other eyes. The symptom is witnessed in its purity during the first days after embolism took place. Far from considering it unintelligible, I think it constitutes a most valuable means of diagnosis, indicating not only the absence or presence of circulation in the retinal vessels, but enabling us to judge, to a certain degree, even on the strength of the current, by observing attentively the vigor of arterial pulsation and the amount of venous dilatation. If now, during the first two weeks of embolism, the retinal vessels are not only exceedingly small, but can not be made to pulsate by a pressure, which in every other eye will have such effect, then the arteries must be choked. And certainly there is a disturbance in the retinal circulation as long as the caliber and the pulsation of the arteries are not restored. This restoration is effectuated by the collateral circulation of the ciliary vessels, not during the first twenty-four hours, but after a longer lapse of time, and blindness, with ultimate atrophy of the optic nerve, is the result; only in exceptional cases of incomplete obstruction the retinal artery itself becomes permeable again, and perfect recovery may follow. (Case IV., Arch. f. Ophth., XIV., p. 217.)

On the other hand Dr. *Steffan* goes on saying that "the embolic obstruction in the above-mentioned deleterious cases must *include with the central retinal artery most of the short posterior ciliary arteries.* Some small vascular

channels of the short posterior ciliary arteries, however, must remain free, to account for the choroidal extravasation in the region of the yellow spot, and for the retinal extravasations near the optic papilla."

I agree with those who have asserted that far more marked changes should reveal themselves in the appearance of the choroid, iris, and vitreous, if most of the short posterior ciliary arteries were obstructed, since the nutrition of the interior parts of the globe is principally derived from these vessels. First, I must differ from Dr. *Steffan* in considering the dark red spot corresponding to the center of the macula lutea as a choroidal extravasation or as a hemorrhage at all. I have observed quite the same appearance in syphilitic and other forms of retinal inflammation, where no great tendency to hemorrhage exists. In syphilitic retinitis the latter is of rare occurrence, and wherever I saw it, it was accompanied by the usual radiating streaks around the optic disc. Hemorrhage, after total retinal embolism, does not only occur in close proximity to the optic nerve, but also in the region of the yellow spot. It is decidedly retinal, since the red spots are observed on the surface of the gray opacity which I saw in one instance cover the center of the macula lutea as well as its environs. Moreover, the red spots followed and covered the retinal vessels. The most striking case of my own observation is that of No. I., l. c., p. 209-212.

Let us now return to the case described in this paper. *How are the extensive hemorrhages to be accounted for?* First, we must notice that the extravasations were not sit-

uated at the border of the infarctus, but were plainly and distinctly visible in its center. The drawing shows that the hemorrhages are most abundant in the middle of the space occupied by the obstructed artery, and only a few and very small ones are at the border. These latter might be accounted for, in the usual manner, by collateral fluxion. In our case the hemorrhages *are venous, perhaps capillary in part*, but not at all arterial. To explain all this we shall trace the succession of the observed symptoms and discuss their causes and significance. The first occurrence is undoubtedly the sudden obstruction of the lower principal branch of the central retinal artery at the place of its first division. The *internal twig*, being completely choked, gave rise to all the pathological and functional disturbances observed. The *outer twig*, though enlarged at its origin, either remained or soon became open enough to convey blood through the minor twigs springing from it. The latter appear in proper color and size, and each of them is even larger than the choked portion of the principal lower retinal branch. No change of structure or function in that part of the retina belonging to these *outer inferior branches* having occurred, we must infer that the obstruction in the outer division of the lower principal branch was either incomplete from the commencement, or became so very soon afterward. The latter condition may have been brought on by contraction of the embolic mass, or by a sufficient anastomotic communication at this place. *The lower inner division* had at once and completely been choked. The patient had noticed the trouble in her eye

when reading a book. She said that after having read for some time in her usual way, she suddenly felt a cloud come over the page, and by closing alternately one eye after the other, she observed that the cloud was before the left eye alone. *The sudden approach of the disorder proves that the abnormality could not have been the consequence of a deep-seated inflammatory process*, for the supposition would be against all analogy that the symptoms of neuritis optica, or of any orbital inflammation should be felt by the patient in their full height in the course of one or several minutes without any premonitory symptoms whatsoever. Here we need not seek long for the explanation; the suddenness of the functional disturbance in conjunction with the endocarditis gives sufficient evidence of the embolic nature of the disease. Every other explanation that has been suggested (see *Stellwag's* Treatise on the Diseases of the Eye, translated by Drs. Hackley and Roosa, p. 665) appears far-fetched and improbable. Even *Mauthner*, who takes particular pains in searching for another explanation, comes to the same conclusion.

Now we shall consider another point of our case. *Is it not possible that the retinal hemorrhages were primary and occasioned the functional disturbance?* At the first glance through the ophthalmoscope they seemed fully to account for the defect in the field of vision, but on closer scrutiny we are brought to another conviction. First, it has never been observed that primary retinal hemorrhage leads to complete and almost instantaneous suspension of the retinal functions. Even in cases of most extensive reti-

nal apoplexy I always found a fraction of visual power remaining, and although dark spots to a certain extent obscured the visual field, yet there was never *a whole quadrant entirely missing* as in this case. Further we see that this is the very quadrant which was to have been supplied with blood by the choked artery. All this gives ample proof that the obstruction of the latter is the primitive phenomenon of the disease.

When did the hemorrhages occur, and what is their origin? We know that hemorrhagic infarctus in other organs, such as the lungs, kidneys, etc. (and ours may be called *a hemorrhagic infarctus of the retina*), are occasioned by embolism. In this case it has for the first time been directly seen in the living body. We recognized the place of obstruction; we saw, for a short distance, the artery extremely thin, although not entirely bloodless; we found, further, its caliber increasing at one definite point, and thence it branched toward the periphery in the usual way. This sudden increase of caliber may fairly be accounted for as the place of juncture between a ciliary and retinal artery. We know by modern researches that anastomoses between both systems will happen in this region, although they do not seem to be of frequent occurrence at such a distance from the optic disc. As soon as the obstruction in the retinal artery took place, the current of blood in the corresponding retinal veins must have been stopped, because the *vis a tergo*, which alone moves the contents of the blood-vessels, failed. The blood seems to have been driven out of the arteries by the contractility of their walls. Aside

from this explanation we may assume conditions to exist in the first stage of embolism similar to those of the approach of death when the motion of the heart stops. There we find the arteries empty and all the blood accumulated partly in the capillaries, but mostly in the veins. This blood is either stagnating, or merely gravitating, and constitutes in the latter case what is called cadaveric hypostasis. In our case the blood first stagnated in the retinal veins. The walls of the latter may have undergone some structural change, as a softening process, for want of nutritive supply and on account of the presence of old blood within them ; but this alone will hardly be sufficient to cause extravasation, since we either do not observe it at all, or merely in a very slight degree, in cases where the central retinal artery is entirely obstructed.

In our case we have to account for the following three remarkable facts that were observed in the retina : 1, *the dilatation of those retinal veins* which corresponded to the obstructed artery ; 2, *the origin of the venous hemorrhage ;* and 3, *the dilatation of the neighboring venous twigs.*

In cases of complete embolia of the central retinal artery, the *veins* have always been stated to be very small in their course through the optic disc and the adjoining part of the retina, *but increasing in size toward the periphery.* This fact may thus be explained. The contractility of the veins being greater in the larger branches, presses the blood out of those portions of the veins which are nearest to the optic disc, that is to say, nearest to the point of obstruction in the artery. In the neighborhood the cen-

tral retinal vein communicates with the orbital veins into which flows that small quantity of retinal blood which is pressed out by the contractility of the central portions of the retinal veins. In the remoter portions, that is to say, nearer the capillaries, the contractility of the veins decreases and the column of blood to be moved toward the next anastomosis gets longer and therefore heavier. Both conditions explain why the remoter portions of the retinal veins contain more blood than the portions near the optic disc, that is to say, near the next anastomosis. In our case, however, we did not only see a diminution of caliber in the central part of the retinal veins, but also a thickening, a beginning of varicosity, in the more distant parts. This may be explained as follows. As soon as the retinal artery was plugged, the blood contained in the corresponding capillaries and veins stagnated except that quantity which was pressed out by the contraction of the walls of the central portion of the vein. Had the system of circulation belonging to the obstructed artery been a separate one, having no communication, or at least an inefficient one, with the neighboring blood-vessels, there would have been no occasion for varicose dilatation of the veins. The retina as a whole, and certain other organs are in such conditions of a more or less isolated system of blood-vessels. As soon as the circulation ceases, the blood stagnating in the veins may be supposed to coagulate and choke the vessel to a certain degree. After some time, the nutrition of the veins and capillaries, as well as that of the surrounding tissue, being cut off, atonic collapse and softening set in. If then,

by continuation of the obstruction of the principal artery, and by want of sufficient anastomoses, the supply of fresh blood be any longer withheld, cadaveric changes—mortification, necrosis—will take place. When, on the other hand, a certain amount of arterial circulation is, as in our case, restored by anastomosis, then the capillaries and veins become filled with an undue quantity of blood, because the previous coagulation in the veins checks or prevents its natural outflow. The veins then being under a higher degree of internal pressure, become dilated, varicose ; and, since their walls, as well as those of the capillaries and the surrounding tissue, had previously been softened, rupture of the vessels and hæmorrhage ensue. The arteries were not the seat of effusion of blood, by reason of their being stronger and of not containing any disoxidated blood that might soften their walls, thus offering a greater resistance to the renewed intravascular pressure.

The dilatation of the terminal branches of the neighboring veins may be ascribed to collateral fluxion, or explained as inflammatory hyperæmia—the morbid exudation from the vessels obstructed by coagula, diffused into the adjoining parts causing œdema and hyperæmia, which is seen in the vicinity of all irritative pathological processes.

How is it that the short portion of the artery between the plug and the entrance of the communicating ciliary branch could remain so narrow? Would not the blood flow backward as well as toward the periphery? The blood will always flow in that direction where it finds an outlet and a continuous current may be established. We may assume

that in the first moment the central portion of the retinal artery was also filled with blood which, finding no outlet, stagnated, and caused the artery to contract. The same phenomena are observed after ligatures of arteries; that portion of the artery lying between the ligature and the next preceding side branch will always shrink, although the blood could go down to the point of the ligature itself. The same condition is observed in the prolongation of a tied artery, between the ligature and the anastomosis next below. When there is no anastomosis at all, the entire prolongation of the impermeable artery will shrink, and in the length of time be metamorphosed into a solid cord. As the latter principally consists of connective tissue, scantily supplied with blood, it will appear like a white string. There could be no better illustration of such a fact than the above-quoted case of Dr. *Saemish*, which has erroneously been adduced as an evidence against the embolic origin of such maladies, and been taken for primary perivasculitis. Not only the history of the disease, however, pleads against the latter supposition, but also the restriction of the morbid change to one retinal artery and its abrupt termination on one definite point.

Thus far I hope to have been able to explain satisfactorily in our case the conditions of the fundus oculi revealed by the ophthalmoscope, and *to add to the many triumphs of this instrument another one, viz., the direct perception of a hæmorrhage in infarctus.*

The *progress of the disease* offered no phenomenon worthy of special notice, other than the *persistency of the*

defect in the visual field, while the morbid alterations of structure disappeared; the effusions of blood being gradually absorbed, the retinal veins becoming less dilated and tortuous, and the retinal tissue presenting only slight differences from the normal appearance.

This fact, however, is quite in accordance with the reports of all cases of complete obstruction of the central retinal artery; the function of the retina ever remains annihilated, although an efficient collateral circulation sooner or later set in to preserve the structure of the retina as far as ophthalmoscopic examination can discriminate it. Important structural changes, however, undoubtedly take place from the first moment of the embolia, and we have good reason to believe that the nervous substance of the retina can not, even for the short interval of time between the plugging of the artery, and the establishing of an efficient collateral circulation, be deprived of its wonted ample supply of arterial blood, without undergoing decomposition of its essential elements. Not only the abolition of the functionary power furnishes an argument for this assumption, but the ultimate atrophy of the optic nerve, which we witness in all cases of embolism of the central retinal artery, is another and more striking proof.

About the prognosis and treatment, there is little to be said in this disease. When the embolus plugs a branch of a retinal artery completely, permanent loss of function in the corresponding part of the retina seems to be the inevitable consequence, as the three cases known up to the present day demonstrate. The intercommunications of the

retinal arteries do not seem to be efficient enough to prevent the nervous elements from destruction, which manifests itself as a permanent loss of vision. The *treatment* can not be said to be very promising of favorable results. Nevertheless, I would not advise physicians to abstain from any treatment at all. As we know that successive emboli originating in the same source are apt to take the same direction in their course through the arterial channels, we must bestow particular care on the cure of endocarditis. Beside the medical treatment, repose of the body, staying in bed as long as endurable, and careful abstaining from every excitement, are strongly to be insisted upon, lest increased activity of the heart may detach new solid masses collected in the left side of the heart or the aortic system. Moreover, increased activity of the heart will increase the hyperæmia and hæmorrhage in the part supplied by the plugged vessel and in its neighborhood. If then we can not restore the full integrity of the affected organ, we may still be able to confine the extent of the pathological changes, and prevent new attacks in the eye, or any other important part of the body.

ON THE FORMATION OF CYSTS IN THE IRIS.

By Dr. L. WECKER, of Paris.

THE number of published observations on the formation of cysts in the iris, is already so considerable, that it is hardly worth while to add to them a new case, but that it will give us an opportunity to describe the manner in which these tumors are formed. In the second edition of my text book (part 1, p. 426), I have already been able to collect twenty-seven cases, to which must be added two cases by Hule, and one by Wordsworth, that have since been published (Ophth. Hosp. Repts., part 6, p. 12).

It will appear strange to every one who has seriously studied the pathological anatomy of the eye, that the iris, which is in such intimate relation with the choroid, should have the exclusive privilege of being the seat of cysts, which are hardly ever met with in the remaining parts of the uveal tract.

We are the more justifiable in being surprised at this peculiarity, as the iris, in comparison with the choroid, contains no elements which might predispose it to the formation of

cysts. Farther, we find in the texture of the iris no tissue which might occasion the formation of tumors of retention (for such without doubt are these cysts).

The case now to be described came under my notice in the summer of 1868, at my clinique, and the observation of this case gave me an opportunity to confirm the opinion which I had already formed with regard to cystic formations in the iris. The drawing (chromo-lith. plate A, fig. 2) represents the right eye of a woman thirty-two years of age, who, when a child of eight years had injured herself with a knife, from which there is still visible on the inner half of the cornea a scar six millimetres long, and forking upwardly into two parts. The vision was, as the patient states, "after the end of the first month, as good as ever," but in the course of some years it had become weak, and at the same time it was observed that a grayish film had spread over the pupil, and had almost completely covered it.

At present the right eye is slightly hyperopic 1-48, acuteness of vision 1-10, and the patient comes exclusively to ask us, whether it is not possible to remove the increasing film by means of an eyewash without an operation. The cyst has a grayish-white, transparent, gelatinous appearance, and forms a large heart-shaped diverticulum, to the inferior part of which a small, round, oblong body is attached. The pupil is, with the exception of a small slit, almost entirely covered, but dilates under the influence of atropine, so that its greatest expansion will measure about five millimetres in diameter.

The anterior wall of the cyst is continuous with the corneal cicatrix, and is slightly flattened toward the posterior surface of the cornea. With oblique illumination one may be convinced that the lens is not pushed backward; that the anterior chamber, in those parts not occupied by the cyst; has a normal configuration. The

trial of the power of accommodation could not be made, on account of the weak power of vision, and the limited intelligence of the patient. The patient would not at that time submit to an operation, as the deformity was slight, and the eye was neither inflamed nor painful.

A careful examination of this case hardly leaves a doubt that the cyst in this instance arose from the strangulation of the iris in the inner part of the wound of the cornea.

The statement of the patient as well as her relatives shows, that a long time after the injury the strangulated part considerably increased in size. Judging from the condition of the remaining portion of the iris, it seemed quite natural to suppose that in this instance we had to deal with a fold of the iris, which caught between the inner lips of the corneal wound, and caused the formation of a sac in this part of the iris.

I have already proved, in reporting another case (see my text book, part 1, p. 427), that a sacculation of a part of the iris may be caused by the attachment of a posterior portion of this membrane by means of a horse-shoe shaped posterior synechia. The analogy between the two cases observed by me was striking.

Nor can we understand what could induce *Hirschberg* (Arch. f. Ophth., vol. 14, part III., p. 295) to say, "that partial protuberance after irido-cyclitis with closure of the pupil, which Wecker enumerates among the serous cysts, might more appropriately be separated from this category, as such simple products of inflammation do not possess a really progressive growth."

It is my opinion that serous cysts are never developed in the iris, and the formations which have been called cysts are the results of sacculation of the iris.

The serous contents which they contain is the aqueous humor, and we may not unjustly classify these tumors, caused by sacculation with progressive distension and thinning of the iris, among the tumors by retention.

As soon as we consider the formation of cysts from this stand-point we can not distinguish between traumatic cysts and those formed by adhesions behind the iris after irido-cyclitis. A progressive growth is proper as well to one as the other, so long as the tissue of the iris is capable of secreting the aqueous humor into the sac formed by it, and this capability not destroyed by a too great thinning of the walls of the cysts, with subsequent atrophy of the vessels.

The inflammatory appearances which may be added to this progressive extension, result partly from the direct tearing of the iris, partly also from pressure upon the neighboring parts.

The anatomical researches of Bowman, Robin, and Van Kempen speak fully in favor of our view, viz., that the wall of the cyst is formed by the rarefied tissue of the iris, and that the uveal pigment, whose cells, more or less degenerated, and bereft of their pigment, forms the epithelial covering of the inner walls of the cyst. In describing the anatomical elements of such a cyst, *Hulke* says (loc. cit.):

"The cyst wall was a delicate homogeneous membrane, varying from $\frac{1}{4300}$ to $\frac{1}{4600}$ in thickness. Its outer surface was overlaid by a net-work of fan-formed cells, identical

with those of the contractile tissue of the iris; and its inner surface was lined by a pavement epithelium, the cells of which differed much in size in different parts of the cyst."

This structure agrees with the description given by Mr. Bowman (Lectures, p. 75, Lond., 1849), and with an observation by Prof. V. Graefe (Archiv, vol. 12, part II., p. 228). Notwithstanding, Hulke quite incomprehensibly comes to the following conclusion: "Since none (? !) of the elementary tissues constituting these cysts are normally present in the iris, they must, in this instance at least, be regarded as new formations, and not simply as distensions of already existing spaces, an alternative suggested by the result of Robin's and Van Kempen's examination of the debris of three cysts."

Our view only differs in one point from that of Robin, viz., in this, that the formation of cysts does not take place by the distension of a pre-existing space in the tissue of the iris, but that this space (a fold or sacculation of the iris) is caused either by injury or inflammation. It can not be denied that elements are sometimes found in the interior of the cyst, which are not normally met with in the iris. But we believe that this has only been caused by the injury. So it may happen that, as in the second case described by Stoeber, a cilia is found in the cyst, and it is not surprising that in a similar manner fragments of Decemet's membrane, the epithelium of the conjunctiva, or the epidermis covering the lower border of the lids, may be embedded in the fold of the iris.

We need hardly mention that we here exclude, with

Hulke, only one kind of cysts, and these are the hollow spaces which are apt to form in myxoma of the iris by the liquefying of the mass. How often, however, will we have a chance of observing these? The thirty-one cases of cysts of the iris which I have collected were almost exclusively serous cysts, a few cases excepted (V. Graefe, White, Cooper, Richard, Stoeber).

As regards the manner of their formation, Hulke says that in twenty cases, eighteen times injuries of etiological moment were mentioned. This circumstance alone, as well as the result of anatomical research which has discovered no new elements in the walls of cysts, are strong proofs that injury simply has given rise to a sacculation of the iris, and that the contents of the cyst are merely aqueous humor.

For those who still doubt that the iris can form such folds, we have only to draw attention to such peculiar cases of depression of the iris as were first described by Von Ammon.

Here a true inversion of the iris was observed, and if such an inversion of the iris toward the ciliary body is possible, are we not forced to admit that only a partial inversion of the diaphragm may give rise to the formation of a fold, and consequent sacculation. The possibility of this sacculation taking place by strangulation of the iris in a scar of the cornea, seems to be sufficiently well proven by the case we have described.

A CONTRIBUTION TO THE KNOWLEDGE OF CONGENITAL FISSURES OF THE LIDS.

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By Dr. L. WECKER, of Paris.

Translated by J. H. & T. R. Pooley, M. D., of New York.

The number of cases of congenital fissures of the lids in medical literature is still so small that it is desirable to publish cases of such malformation whenever they are observed. There is the greater reason for this when such a case throws light upon the simultaneous development of similar malformations, and of the eye itself.

The case of coloboma palpebræ now to be described is the tenth which has hitherto been recorded, at least so far as our researches reach.

The nine preceding cases have been described by Mayer,*

* Thèse sur quelques maladies congénitales des yeux. Montpellier, 1808, p. 11.

Beer,* Heyfelder,† Von Ammon,‡ Cunier,§ Von Graefe,‖ O. Becker,¶ Horner,** and Manz.††

To the last of these authors belongs the credit of having written more thoroughly on the origin of this malformation and of directing attention to the frequent co-existing malformation of the surface of the globe of the eye.

The case described by Manz is also most important as throwing some light upon the mode of development of coloboma, since cutaneous bridges arising from the cornea of both eyes were extended between the congenital fissures of the lids toward the skin of the forehead.

Manz now puts the question whether this defect of the lids might not be explained by the remaining of these portions of the integument, the more so as in the phases of development of the lids there is no reason to be found for a permanent fissure.

The lids arise as similar folds of skin on the borders of the orbit, and grow over the already developed globe of the eye.

According to V. Ammon‡‡ the development of the lids and the later union of their tissues takes place about the end

* Das Auge, etc. Wien, 1831, p. 51.

† Zeitschrift für die Ophthalmologie, V. Ammon. 1831, p. 480.

‡ V. Walther & V. Ammon, Journal für Chirurgie und Augenheilkunde, Bd. 31, 1, H., p. 96. 1835.

§ Annales d'Ocul., T. vii., p. 10. 1842.

‖ Archiv für Ophthalmologie, B. IV., Abth. 8, p. 269. 1858.

¶ Arlt, Krankheiten des Auges, B. III., p. 376, Wien, 1858; and Med. Wochenschrift, Nos. 16–18, 1863.

** Klinische Monatsblaetter, B. II.. p. 180. 1864.

†† Archiv für Ophthalmologie, B. XIV., A. 2, p. 145. 1858.

‡‡ Archiv für Ophthalm., Band IV., Abth. 1, p. 15. 1858.

of the second month. Simultaneously with the formation of the lids and during their union, we are justified, according to the researches which have been made, to take it for granted that the cuticular covering which evenly invests the eyeball becomes transformed, by a histological metamorphosis, into the conjunctival covering of the globe and lids.

This portion of the skin participates more or less directly in the formation of the lids (conjunctiva palpebrarum).

Manz, in his paper, comes to the conclusion that the formation of coloboma of the lids essentially depends on an *abnormal histological transformation* of an originally normal connection existing between the anterior surface of the eyeball and the common integument, thus preventing the formation of a perfect upper lid. We believe it to be more in accordance with the laws which govern malformations in general, to ascribe the formation of palpebral coloboma simply to an arrest of development. We here have plainly not to do with an abnormal histological transformation, but with an *arrest* in the histological transformation; in other words, the cutis, which should be changed into conjunctiva, has remained as such to a greater or less extent, and for a longer or shorter time.

The proof of this assertion is found in the study of those cases of coloboma which are complicated with congenital malformations of the surface of the globe of the eye, such as pieces of skin, dermoid tumors, thickenings of the conjunctiva (lipomata?), and of simple corneal opacities.

The more marked the formation of the coloboma, the

more also that portion of the anterior covering of the surface of the globe which corresponds to the defect of the lid bears to the character of the cutis. We are enabled, therefore, as it were, by the study of these cases to follow the transformation of the cuticular covering into the conjunctiva.

The case of coloboma observed by us, and represented in Fig. 3, Tab. A, is that of a young man aged thirty, who in July, 1860, was brought to one of my consultations by a friend.

He himself did not consider the deformity of his eye, which had existed from earliest childhood, of sufficient importance to ask my advice. The right emmetropic eye of normal vision, which alone is affected with coloboma, exhibits on the upper lid, toward the inner part, a defect which is about 4 mm. high, and which is bounded by a delicate, finely corrugated, shining skin toward the margin of the orbit.

The edge of the lid is toward the lower angle of the coloboma, furnished with thick cilia. If we evert the upper lid we may easily be convinced that the upper tarsus, corresponding to the coloboma, is divided into two parts, of which the inner one represents a small triangular rudiment on which the Meibomian glands are distinctly visible. On the inner border of the cornea is to be seen a small slightly elevated dermoid tumor, somewhat pear-shaped and destitute of hairs. At the inner side of this cutaneous wart, directed toward the corneal tissue, was a whitish, crescent-shaped opacity, which resembled very much a partial arcus senilis.

On closing the eyelids, this cutaneous wart exactly filled in the notch formed by the coloboma of the upper lid.

It is worthy of notice that with the exception of the cases described by Cunier and V. Graefe, the coloboma

congenitalis has always been observed on the upper lid, whilst in the case described by Graefe, on the contrary, the coloboma existed on both lids of the same side ; the case described by Manz is the only one which presented a congenital fissure on the upper lid of both sides.

If we compare the ten cases of coloboma which have so far been described, in order to discover what kind of malformations are simultaneously found on the surface of the globe, or on the latter itself, we see, according to Manz, Becker, and Horner, pieces of skin, more or less connected with the eyeball, insert themselves between the abnormal palpebral fissure.

In the cases of Mayer and V. Ammon, thickenings of the conjunctiva proceeded from the coloboma toward the cornea, in the shape of a third lid. The presence of a symblepharon after the union of the margins of the coloboma in Cunier's case seems also to indicate a similar pre-existing thickening of the conjunctiva. In the case of V. Graefe, as well as of V. Ammon, and my own, we find on the boundary of the cornea, corresponding to the defect in the lid (Graefe, Wecker), small dermoid swellings.

There remains only the cases described by Beer and Heyfelder, where there is no mention made of any co-existing malformation of the surface of the globe.

Beer, however, says that the transparent cornea was conical in form, whilst Heyfelder says that the upper segment of the cornea was flattened.

From this survey of cases it follows with certainty that until now the congenital fissure of the lid has not been ob-

served without co-existing malformation of the eyeball itself.

We should depart from the safe ground of direct observation, if at present we were to trouble ourselves with researches as to how far the persisting of a circumscribed part of skin upon the surface of the globe might more or less certainly become the cause of a fissure of the lid. From observations made it is evident that the arrest of this involution (or, more correctly, metamorphosis), may be more or less temporary, and be limited to so small an extent that no fissure of the lid results from it.

The by far more frequent occurrence of dermoid swellings on the edge of the cornea, without co-existing coloboma of the lid, is a certain proof of this. Highly interesting in this respect is the case described by Horner, where, upon one side, a central bridge of skin inserted into the cornea was complicated with coloboma, whilst, upon the other side, there were two principal dermoid swellings situated at the lower part of the corneal margin, without coloboma of the lids.

About thirty years ago Professor Riba had already asked the ophthalmic surgeons whether coexisting dermoid swellings of the globe had not frequently been observed in connection with congenital fissures of the lid.

This author believes that in consequence of imperfect or delayed partial closure of the lids, the conjunctiva takes on the character of the cutis and forms itself into cutaneous warts.

* V. Ammon's Monatsschrift, Bd. i., p. 658. 1838.

Now this statement is to be taken entirely in a reverse sense, and we arrive at the conclusion that the non-occurrence of the involution, or rather metamorphosis, of a circumscribed section of the skin of the eyeball, is the cause of the formation of dermoid tumors. And at the same time, if this arrest of transformation is of sufficient duration, or, extended to a sufficiently large degree, it is the cause of the formation of coloboma.*

As we are entitled to assume that the cutis covering the globe during the formation of the lid is transformed simultaneously to the conjunctiva of the globe, and the developing lids, we may without hesitation assume that an arrest of this metamorphosis is to be considered also as an arrest of development of the lids (conjunctiva of the lids).

We have therefore in the formation of a fissure simply an arrest of development.

* We beg, in cases where dermoid swellings are to be observed, that the lids may be very carefully examined, to see whether there be any indications in the outer integument, or in the conformation of the tarsus, which points to the existence of a coloboma during intra-uterine life.

CATARACT EXTRACTION OPERATIONS.

By HENRY W. WILLIAMS, A. M., M. D.,

President of the American Ophthalmological Society, Ophthalmic Surgeon to the City Hospital of Boston.

The attempts to improve the results of operations for cataract, may be regarded as among the most notable of the endeavors made by the disciples of our modern school of Ophthalmology. Scarcely had flap extraction been everywhere accepted as the substitute for operations by displacement, before numerous innovations were proposed—each of them, according to the assertions of its authors and partisans, affording a previously unknown percentage of success.

Great advantage has already accrued from these praiseworthy efforts to increase the ratio of favorable results, and we can foresee yet greater benefits to be derived from the labors of so many earnest inquirers. Inspired by motives of generous emulation and loyal devotion to true scientific research, they have not hesitated, on the one hand, to discard some old traditions which have not borne the test of modern observation, nor, on the other, have they been too readily daz-

zled by the averred excellence of the results attained by certain new methods without taking into account all the elements which might have contributed to their success—or been disposed too hastily to generalize flattering statistics which may have depended on the special skill or experience of some operator, and thus to place too high a value upon certain maneuvers, without inquiry as to whether their alleged advantages might not, perhaps, have been obtained by other means.

Among the questions which seem to have been satisfactorily determined by these experiments, may be reckoned demonstration of the safety, and oftentimes the great advantage, of the use of anæsthetics in cataract operations. Among those as yet *sub judice*, and deserving of most careful and unprejudiced investigation, may be ranked some of the recently proposed modifications of operations for the removal of the lens, combined or not with iridectomy.

The fallacious value of temporary success is proved by the experience of almost every operator, who can adduce, here and there, a long sequence of invariably happy results,—but who finds his fortune changed, and his favorable average reduced in his next series of cases, although he pursues the same method, and exercises no less care and skill.

Even a wide-spread popularity has sometimes proved to have been undeserved. Only a short five years have elapsed since extraction by out-scooping, claimed as rendering success a certainty, was adopted by many of the most skillful and judicious operators in all countries, as an undeni-

able improvement in operative procedures. Yet, on a more extended trial, this favorite was left to neglect by even its most ardent admirers. Again we were assured that iridectomy, *per se*, was an almost absolute safeguard, and large portions of iris were excised without much regard to cosmetic effects, or to its uses as a diaphragm.

Time must show whether other new modes, yet more recently invented, are to be definitively accepted as truly conservative in conducing to the *permanent* recovery of vision, or are to be laid aside after merely ephemeral favor. Unquestionably the very best result, when attained without accident, is that which follows simple extraction of the lens, through a corneal section, without further mutilation of the components of the globe. Its principal dangers are well understood. The problem to be solved is, are these to be safely obviated by some or any of the new methods; or have these methods inherent dangers of their own, so that our attempts may perhaps be made, with more profit, in other directions.

Other things being equal, there can be no doubt that the farther the cicatrix of the incision can be removed from the ciliary region and the anterior of the choroid and retina, the greater the chance of ultimate safety, as these delicate tissues will be less implicated in any subsequent contraction. Sufficient time has not yet elapsed to enable us to judge as to the influence which operations through the sclera may have in causing separation of the retina; but it is reasonable to suppose, that, apart from any effect produced by the situation of the cicatrix, separation will be favored by the

loss of retinal support consequent upon the excision of a portion of the iris, especially if conjoined with a rupture of the hyaloid and diminution of the mass of the vitreous. This fatal change, supervening as it does only after a lapse of time, has perhaps not been sufficiently considered among the eventualities of extraction operations.

An incision in the sclera, combined with iridectomy, should certainly be expected to afford a ready exit to the lens; yet, practically, it is found, that after the section, as now made, larger portions of cortical substance are left behind, to be expelled by after manipulation, than in ordinary cases of flap extraction. This would indicate insufficiency of size of the section to admit of the easy escape of the lens. Yet, the incision can not safely be enlarged, inasmuch as it is already of such position and extent as frequently to allow the loss of a portion of the vitreous,—and as a large scleral wound would be liable to separation of its edges and a tardy union.

Unquestionably, flap extraction, by corneal section, as performed under the influence of anæsthetics, will bear favorable comparison with itself when done without their aid. Its maneuvers can be more delicately executed, with less contusion of the cornea and iris, than upon patients who, as formerly, were more or less intractable, or, at best, unable wholly to control the movements of their eyes. The lens may be slowly and carefully coaxed out, without fear of its sudden ejection in consequence of spasmodic compression of the eye by its exterior muscles, and fragments of cortical substance are less likely to remain within the

eye, or, should they be left behind, they may more readily be removed.

The advantages of the corneal flap extraction may be much enhanced, and its dangers materially lessened, in my judgment, by *the use of a suture to retain in apposition the edges of the wound.* Securing a more immediate union, we not only avoid ulceration of the border of the flap, and prolapsus iridis with its attendant evils, but the prompt restoration of the fullness of the globe, and of the normal relations of its several parts, lessen the chances of irritation, from pressure of any cortical fragments or remnants of capsule upon the delicate contiguous structures, and the occurrence of irido-cyclitis. This suture, a single strand only of the finest glovers' silk, passed through the edges of the wound by means of a very minute, short needle, held by forceps, can be tolerated, without detriment, even in the cornea; but at present I am disposed to extend the corneal flap at its apex a little way into the conjunctiva, so as to allow of the placing of the suture in this membrane, where it is more easily inserted than through the tougher corneal tissue.

Should experience approve the substitution of other modes of forming the section for those heretofore or now in favor, the suture may still find its application, in promoting the safe and rapid recovery of the eye, as it could equally well be employed whatever method might be preferred.

REPORT AND REMARKS ON A THIRD SERIES OF ONE HUNDRED CASES OF CATARACT-EXTRACTION BY THE PERIPHERIC-LINEAR METHOD.

By H. KNAPP.

Von Graefe has given us a full account of the principles and details of his new method of extracting cataract, which he now very appropriately calls "peripheric-linear." Not so exhaustively has he published the accidents and disturbances which are liable to occur during the operative procedure and the healing process, nor has he fully acquainted us, in the way of detailed statistics, of the primary and final results, and the necessary or desirable and feasible after-operations. The general practitioner is certainly more inclined to read only a summary statement of the results than a minute description of the reverses of the method. But all who are engaged in ophthalmic surgery will be benefited by nothing more than an exact report of the unfavorable cases. If I were allowed to express myself figuratively, I should say: We are intimate friends of Graefe's operating room, but only casual visitors of his hospital wards. Certainly *Von Graefe* has not failed to give us a general out-

line of his statistics, and I am sure that only want of time has prevented him from presenting a detailed account of his unequaled experience, which would be of no less value than the description of the operative procedure; for the knowledge of the adverse occurrences is the origin of improvement. The proverb says: "Necessity is the mother of invention."

Having been among the first who had and took the opportunity to learn the method from the originator's hands and to try it on a large scale, I have already reported twice on one hundred cases each time, and am now about to add a series of a third hundred, all operated on by me during the summer of 1868. One hundred extractions constitute a fair number of cases which, when carefully watched in their course, can not fail to teach useful knowledge. With regard to the exactness and reliability of the following and my former statements, I may mention that my hospital wards have been always open without restriction to medical visitors. Hardly one operation has been performed at which there were not some competent witnesses present. The nature of the cataract and the accidents of the operation were always recorded by the first assistant surgeon having charge of the medical book-keeping on all the in-door patients. During the regular daily visits through the rooms, I examined, treated, and bandaged every patient myself, and had the necessary observations noted in the diary. The last examination, at the discharge of the patient, was always made by the first assistant, its results, as to the conditions of the eye and its visual acuteness, entered in the journal, and

afterward controlled by myself. In this way I possess the fullest notes possible on my cases, and can at any time have resort to my clinical journals. Having no claims to the invention of the method of operating I may be credited for impartiality in my reports. I dare say that I made all the particulars of the operation an object of unwearying studies, both theoretical and practical. An extended practice having given me some skill in its performance, the following statements may be considered as faithful and objective as they possibly can be made.

QUALITY OF CATARACT.

The quality of the cataract with regard to consistence, size, maturity, and composition (simple opacity, or fatty, chalky, and other degeneration), is of the highest import concerning prognosis and indications. The following statement is the summary of the observations I have made in these one hundred cases :—

69 *eyes had mature cataract* of either hard or soft consistence ; 66 of them were operated on with full, 1 with a half success, and 2 were failures. The operations in the latter cases were without any accident, but two were followed by iritis, of which the former ended with a pupillary membrane, the latter became purulent and destroyed the eye. In the third case primary corneal sloughing set in. In five cases out of these 69, the operation was complicated with slight accidents ; three times an escape of some drops of vitreous during the attempt of removing the remainders, twice pro-

lapsus vitrei before the exit of the cataract. These five cases all healed well.

13 *cases had immature cataract*, that is the *cortical layers* were partly yet of *normal appearance.* 10 of the 13 cases proved perfect results, 1 a failure, and 2 imperfect results. The operations, with one exception, were without accidents, and only in two a quantity of lens matter remained in the eye. In the one exceptionable case escape of vitreous happened before the exit of the lens, the cortical layers of which remained, to a considerable amount, within the eye. The patient was 80 years of age and operated on during the warmest days. The concurrence of these unfavorable conditions with the accidents of the operation, occasioned purulent iritis and destruction of the globe. Of the 2 cases of half-success one had been operated on without accident, but was followed by plastic iritis with a dense pupillary membrane; in the other I was not able to remove the lens matter sufficiently.

In 8 *cases the cataract was hypermature.* In 3 of them there happened prolapsus corporis vitrei during the operation, one of which was followed by iritis and proved only a half-success ($S=\frac{1}{60}$), the others were perfectly good results.

In the remaining 10 *cases the cataract was cortical only;* 9 of them resulted well. In the tenth the operation was without accident, the lens came out clear and complete, but after-hæmorrhage ensued. This caused chronic hyperæmia of the iris, and pupillary opacity, $S = \frac{1}{20}$ only.

The experience of this latter group of cases, as well as of similar ones operated on formerly, has satisfied me that the

maturity of the corticalis is far more important than the maturity of the nucleus. The nucleus, being opaque or not, will always come out without difficulty, if only the corticalis can be clearly removed. This may be done if the stripes adjoining the capsule are sufficiently opaque. I have extracted many such cortical cataracts in which the nucleus had hardly begun to show any turbidity. Cases in which the posterior cortical layer is opaque, the nucleus transparent, and the anterior cortical layer but slightly, if any, affected, commonly show an extremely slow progress, causing for a long time considerable impairment of vision. In former years I used to puncture the anterior capsule of such cataracts, and extract the latter, after the anterior corticalis or the whole lens had become opaque. Of late I have extracted the whole lens at once, taking care to lacerate the anterior capsule very freely, and to extract as much of it as I could. In one of the latter cases there was a circumscribed, dense opacity in the centre of the posterior surface of the lens, having an apparent diameter of about 7 millimetres. I succeeded in extracting the lens completely, but this posterior opacity remained behind. I thought it was a thickening of the posterior capsule, and, therefore, did not at once interfere with it. The eye healed, the opacity remained unchanged just behind the pupil. Some weeks later I lacerated it with a needle.

OPERATIVE PROCEDURE.

The more cases I operated upon, the more closely I followed the method of *Von Graefe* in its details. I may add

that this was not done out of blind imitation, but my own experience gradually forced upon me the importance of the rules insisted on by the author of the method. I made a good many trials, going as far as the safety of the patient would allow, but my routes nearly always converged to the same point which *Von Graefe's* genius and his greater experience had already arrived at. I shall point out some of the particulars of the operative procedure, the good results of which were further confirmed by the experience of this new series of one hundred cases, and express my views on what remains doubtful and unsatisfactory.

As to the *form and size of the knife*, the discussions of the Heidelberg Congress proved that I had already come to the same opinion which *Von Graefe* expresses so stringently in his last article (Arch. f. Ophth., XIV., 3, p. 116). "The knife should be as narrow as solidity will permit." By being narrow its passage through the anterior chamber, from puncture to counter-puncture, prevents the increase of intraocular pressure to any considerable degree, which might cause escape of aqueous humor. The deeper the chamber, the easier the knife is guided in the exact way intended by the operator, and even a false direction may be instantly corrected by drawing the knife backward as much as is required.

Endeavoring always to make puncture and counter-puncture as peripheric as possible, I sometimes observed that *the point of the knife became engaged in the iris.* This never took place at the insertion of the iris, but on some point of its anterior surface, mostly at the annular elevation produced by the circulus arteriosus iridis minor. When this

accident occurred I drew the knife backward until its point was disengaged, lowered the handle a little, and proceeded with the operation as if nothing had happened.

Taking great care that my knives were very sharp, I often had them at the instrument-maker's. By the repeated grinding, the end of some of the knives became so much thinned, narrowed, and pointed, that I failed to place the counter-puncture as peripherically as I had intended, because I could not longer see or calculate the exact position of the point of the knife when it was hidden behind the non-transparent peripheral zone of the anterior chamber. So it occurred that, while I was still pressing the point of the knife backward in order to get a peripheral counter-puncture, the point had already entered the corneal tissue more in front than I liked. The end of the knife being very thin and flexible I felt the resistance no sooner than I saw the blade being markedly bent. Sometimes I have been much afraid of the point being broken in this way. In order to rectify the false position of the counter-puncture, I withdrew the point out of the corneal tissue and turned it behind the sclerotic margin. When the blade is narrow and of equal size throughout its whole length, this correction may be made without the slightest escape of aqueous humor or any perceptible change in the conformation of the anterior chamber. If the point of the knife is not elongated, it will last longer, break less, and not require so extensive a drawing back in case its position should need correction. Morever, such a false direction is not so apt to occur because we see its end more distinctly than when it is threadlike. I think all these

advantages of a short point over an elongated one are appreciated enough in general surgery; but I found that, in the fabrication of Beer's cataract-knives, only the best instrument-makers in England paid due attention to them. The most appropriate shape of the knife for peripheral linear extraction I found at *Luër's*, in Paris. The blade is a trifle broader than 2 mm., begins to decrease in breadth 5 to 6 mm. before the point, but so slightly at first, that about 1 mm. before the end-point its breadth is still 1 mm. In this way a marked diminution of breadth for the purpose of forming the point is reserved to the last two millimetres. The back edge of the terminal portion of the blade is likewise sharpened as far as three millimetres backward. The surfaces of the blade are plain, and this I think more to the purpose than having them convex, the latter variety being less sharp, A somewhat hollow surface of the blades would increase the sharpness of the cutting edge, but soon find a limit by the danger of diminishing too much the durability and strength of the instrument already delicate enough.

About the section I have nothing new to suggest. I will only briefly repeat what I have said in my former report. On the surface of the globe, the whole section lies within the sclerotic. Its middle point is half a millimetre distant from the corneal margin, and, for large cataracts, extends so far laterally that perpendicular lines dropped from its extremities will touch the cornea as tangents. For smaller cataracts the middle of the cut remains the same, but its extremities do not reach so far laterally. I have expressed the reason for this rule in my former report (Arch. f. Ophth., XIV., 1, p.

291, &c.). Formerly I often placed the apex of the cut more toward the periphery. This, however, renders the expulsion of the lens difficult, and is apt to lead to prolapse of vitreous, without, as it now seems to me, preventing suppuration in a corresponding degree, so as to make amends for these drawbacks. Before the puncture, I determine with my eyes the location and size of the section, and try to hold the knife in such a way that its surface remains as much as possible in the same plane from the beginning to the end of its passage. By practising on the cadaver, I found that in this way the cut-surface becomes the most regular, whilst I sometimes was astonished to verify how irregular the section may be at its extremities, especially the outer, when the knife, in entering the anterior chamber, is held parallel to the plane of the iris. I have not a little improved in judgment on the means of obtaining a good section, and its qualities, by these experiments on the cadaver, affording a thorough inspection of all its irregularities.

Concerning the mode of excision of the iris, I have nothing to add to what *Von Graefe* says in his last article. I was acquainted with his views and practice on this subject by personal intercourse, and followed them in all the operations of this series. The iris is seized not in the middle of the wound, but somewhat nearer to its temporal extremity, gently drawn out and cut by three strokes of the scissors as close as possible to the borders of the wound. If then the sphincter edge of the coloboma does not spontaneously recede to its proper place, gently rubbing on the corneal edges of the wound with the hard india-rubber

curette is resorted to, until the pupillary edges of the iris are quite disengaged from the wound. The laceration of the anterior capsule, in all cases of mature and ordinary cataract, was done cautiously, but very freely, and in different directions. Whenever the capsule was thickened by deposits of any kind, I circumcised, with the cystitome, the part corresponding to the coloboma and extracted it. I succeeded in doing this, in some cases, with the cystitome itself, the point of which, after the circumcision of the thickened part of the capsule, was carried near the lower edge of the pupil, quite opposite to the apex of the cut, in order to catch the said portion of the capsule and drag it out. In other cases, when this procedure would not attain the desired effect, I extracted the loosened portion of the capsule by means of a pair of delicate forceps. I suppose that *Liebreich's* forceps,* with teeth at the convex side of its curve, will be very serviceable for extracting the anterior capsule.

In the art of *expulsion of the lens* I followed the procedure I advocated in my former report. While an assistant steadies the eye, the operator presses, by means of a flat spoon, the posterior lip of the wound backward, at the same time pushing with the india-rubber spoon, the lens through the opening. It seemed to me that the expulsion was the most facilitated in this way. In some cases of old, dislocated, or trembling cataracts I introduced a large, but rather flat, spoon behind the crystalline, and extracted it with the capsule. In the rare cases of prolapse of vitreous

* See his Article in the present number of these Archives, p. 22.

before the expulsion, I extracted the cataract with the same spoon, when the lens did not enter the wound readily by the pushing maneuver. I beg leave to say that I use a large spoon only for large lenses that fill it. They will then come out readily, with or without the capsule, even when adherent to the iris, in which case it mostly is unnecessary to break the synechiæ previously with a hook. Loose shrunken lenses or hard floating nuclei are best seized and extracted with suitable forceps.

ACCIDENTS OCCURRING DURING THE OPERATION.

Bad accidents during the performance of the operative procedure were less frequent than in the former two hundred cases, which I ascribe both to the improvements of the method, and to the acquirement of greater skill on my part.

Only twice there remained within the eye *considerable lens matter*, causing in one case purulent capsulitis, with $S = \frac{1}{20}$, but very good prospect for subsequent discision of the pupillary opacities; in the other case no inflammatory reaction followed, and the patient was dismissed fifteen days after the operation with $S = \frac{1}{10}$. Six weeks later, I performed discision of the pupillary opacities, which operation, in the course of 5 days, raised S from $\frac{1}{10}$ to $\frac{1}{5}$.

Hæmorrhage into the anterior chamber during the operation was not infrequent, but the blood was almost always evacuated at once by pressing gently on the cornea with a soft sponge; only in rare instances I was obliged to take the speculum away, lift the wound a little by means of a blunt spatula, and squeeze the blood out by rubbing with

the lower lid over the cornea. In all the cases I succeeded in getting the anterior chamber clear, so that I could dilacerate the capsule, while keeping constantly the point of the cystitome in view.

Prolapse of vitreous occurred nine times under the following circumstances:—

Twice it was only one drop coming out during the trials of getting the remainders clearly out. Both eyes healed without irritation, with $S = \frac{1}{6}$ and $\frac{1}{7}$ respectively.

Twice it occurred in eyes with shrunken cataracts. The first was calcareous and disciform in an old woman. Such cataracts are difficult to get out. In this case vitreous escaped during the pressure of the spoon on the cornea. I succeeded, nevertheless, in pushing the cataract out without being obliged to enter the eye with an instrument. Healing perfect; $S=\frac{1}{10}$ in an eye unhealthy apart from the cataract. The second case was a soft cataract, with many earthy and fatty deposits on the capsule. After the exit of the lens I tried to extract the anterior capsule, but in this attempt I ruptured the hyaloid fossa, and some vitreous escaped. This had the advantage to push the capsular opacities aside, and form a clear pupil. The patient had no trouble, and was very soon discharged with $S = \frac{1}{4}$. The *fifth* case was that of an excessively myopic eye, in which I presupposed the vitreous to be fluid and other changes present. I therefore extracted the lens with its capsule by means of a large spoon. The operation was done easily, and complicated with prolapsus vitrei only to a limited extent. The eye healed without trouble, but regained no higher

visual acuteness than $\frac{1}{40}$, on account of choroidal atrophy. In *two other* cases vitreous escaped before the exit of the lens by unusual pressing on the part of the patient. One eye healed well with $S=\frac{1}{10}$; the other, in which considerable portions of lens matter remained behind, was destroyed by suppuration. Both accidents, and the unfortunate termination of the latter case, might possibly have been avoided by using an anæsthetic.

The *two last* cases of prolapsus vitrei were brought about by slight dislocation of the lens with the cystitome. In former times I was more liable to incur this faulty step, of which other surgeons also are guilty even oftener than they are aware of, as I satisfied myself in seeing them operate. Although a slight dislocation of the crystalline is easily produced, when the section is peripheric and the zonula brittle, I think it may, with proper care, be reduced to exceptional instances. The two cases above mentioned did well, one obtaining $S = \frac{2}{7}$; the other, $S = \frac{1}{10}$.

Making a summary of all the operations in these one hundred cases, it ensues that there were eighty-nine operations executed without any accident whatever from the beginning to the end, and of the eleven operations accompanied with untoward accidents, four only can be laid to the charge of the operator. This is, I think, not an unfair percentage, but impresses, nevertheless, the writer of these lines very strongly with the conviction that further unremitting study, care, and practice is needed to perform every step of this admirable operation with the greatest possible neatness and safety.

COURSE OF HEALING.

The close observation of the healing process, after the operation, is instructive in the highest degree. Living in one wing of the Ophthalmic Institute, and not doing any out-door practice, I was particularly favored in watching my patients most carefully without losing much time by it. Twice a day I made the visit to the patients with the clinical assistants who were directed to take notes of every incident of any significance in the course of healing.

The diverse untoward circumstances which occurred after the operation were *after-hæmorrhage and inflammatory troubles.*

Six cases of the former are noticed. In the five first it occasioned no harm, and did not interfere with a speedy and favorable healing, the patients obtaining, respectively, $S=\frac{1}{4}$, $=\frac{1}{4}$, $=\frac{1}{8}$, $=\frac{1}{4}$, $=\frac{2}{5}$, after early discision of pupillary opacities in the latter. The sixth case, however, ultimately became the most distressing of the whole number.

Both eyes of a man, sixty-four years of age, and rather feeble in health, had cortical cataract. The left was first operated on without accident, and healed in the most pleasant way. Therefore the patient acceded gladly to my desire to operate also on the other eye, which I did without encountering any difficulty whatever. He felt well, and could see distinctly after the operation. During the night, however, he had considerable pain, and the next morning I found the anterior chamber filled with blood. The cornea looked clear, the wound was perfectly closed, and there existed but little redness of the conjunctiva. My expectation that the blood would

soon be absorbed was not realized. A moderate degree of irritation being kept up, and the blood becoming rather dark, I performed, the seventh day after the extraction, paracentesis of the anterior chamber, in order to let the blood out, which still filled two-thirds of the latter. As soon as the pupil was free, there was blood observed also in the vitreous. The healing went on slowly, and the patient was dismissed twenty days after the extraction of the cataract from his second eye. This was not yet clear in its interior, and showed $S = \frac{1}{20}$ with a perfect field of vision. The first eye was quite healed, and had $S = \frac{4}{7}$. A fortnight later the patient came back, having iritis of the eye last operated on, and again hæmorrhage into the anterior chamber. In a few days the blood disappeared, the eye beame white, and the patient went home again, hoping that now the eye was out of danger. Not a long time afterward he returned to me with a new attack of iritis, and this time in *both eyes*. He soon improved, and left the institution with tolerable sight in both eyes. At home the inflammation began anew, and I am informed that six months after the operation both pupils were closed, the eyes possessed good perception of light, but showed some slight diminution of tension. The patient refused, at this time, any further operation.

This most distressing case furnishes a proof that after-hæmorrhage, although having generally no bad consequences whatever, may in exceptional cases, lead to severe iritis, and even cause sympathetic trouble in the other eye. Whether the latter would have happened, if only one eye had been operated on, I am unable to tell, but this much is certain, that an eye recently operated on is more predisposed to respond to irritation from any cause than an entirely well-conditioned one. The greater safety of *Graefe's* operation for cataract gradually dispelled my fear of operating on

both eyes at the same time, or shortly after each other, and this just described case, is, out of 330, the only one I have to regret having operated on both eyes at so short an interval. But what operator would not feel justified in acting similarly under the same circumstances? The patient coming from abroad, with cataract in both eyes fit for operation, one eye operated on and healing without any irritation; should we not be allowed to operate on the other eye six days after the first, or should we wait, and how long? I do not think any rule can be laid down for such questions. There will always be some cases proving exceptional to every rule.

Now what is the cause of this after-hæmorrhage? In many cases I could positively ascribe it to some injury of the newly united wound. The patient had either hurt himself, or rubbed his eye forcibly, or done it some injury of a similar nature. Rubbing is certainly a most frequent occurrence with all freshly healed wounds, and it may be done during sleep quite unconsciously. While I am convinced that a large number of after-hæmorrhages are traumatic, I am just as satisfied that some cases, and certainly the worst of them, have another cause for the bleeding. Especially when the blood does not only fill the anterior chamber of the eye, but the vitreous also; moreover, when the effusions repeat periodically, then they certainly do not originate in the wound but in some portion of the uveal tract. How to foresee such a predisposition, how to prevent the ecchymosis, and which is the most effectual mode of its treatment, I am not prepared to indicate. The above

unhappy case is sufficient to cause me not to look any longer on after-hæmorrhage as a trifle, but to inquire after the patient's eye, constitution, and habits with regard to such a predisposition; moreover, to lead the after-treatment carefully, holding every excitement and restlessness as far from the patient as possible, nor dismiss him too soon from the circumspective control of an ophthalmic surgeon.

Among the different inflammatory processes following the extraction, iritis was the most common. It happened seven times in these one hundred cases. Since most of the failures and bad results are comprised in this series, I shall analyze them carefully as to the causes and consequences of the iritis.

Two out of the seven *healed* with perfectly good results, having, respectively, $S = \frac{2}{7}$ and $\frac{1}{5}$.

The first showed only slight iritic symptoms. Some drops of vitreous had escaped in the act of cleaning the eye from remnants. Patient left the hospital fifteen days after the operation. The second showed discolored, but dilatable pupil, and marked circumcorneal injection. Slight pupillary opacities with $S = \frac{1}{5}$. Discision nineteen days after extraction raised S to $\frac{1}{2}$.

Three healed with occlusion of the pupil.

The first was an old decrepit lady with gouty swellings of the limbs, and cataract in both eyes, which were operated on at the same time. One healed well, the other had severe acute iritis, terminating in closure of the pupil. In about six weeks the eye was free from irritation, of normal tension, with no protrusion of the iris. The pupil was clearing so that the fingers could be seen. The lady

was quite content with the one good eye, but the chances for instituting an artificial pupil were very promising.

The second was acute iritis in a woman seventy-four years of age ending with closure of the pupil, but good perception of light, and normal tension of the globe. Here, too, the chances of an artificial pupil were very great.

The third was the worst of the three. Acute purulent iritis healed with dense occlusion of the pupil and protrusion of the iris. Perception of light good. —T? In this state the patient was dismissed nineteen days after the operation. Four weeks later the inflammation had subsided, the pupil cleared up a little, and the anterior chamber deepened. She was able to count fingers near the eye. Three weeks later again, I instituted an artificial pupil by excising the central part of her pupillary membrane. She obtained a very beautiful central pupil, and left, nine days after this operation, with $S = \frac{1}{8}$, although the eye was still red. I do not doubt that her sight will be quite good when the inflammation, after the second operation, has disappeared.

Judging from this case, and others of my previous experience, I should do injustice to the results of this operative method, were I to insert the two previous cases among the failures. They will, therefore, appear among the imperfect results.

The two *failures* were destructions of the globe initiated by purulent iritis and so-called ring-abscess. The first was after a perfectly smooth operation, manifesting not the slightest reason to account for the fatal issue. Such cases will always puzzle the medical man very much. The second failure was a panophthalmitis too, brought about by the concurrence of several causes,—a frail woman, 80 years of age

—the hottest days of the exceptionally warm summer of 1868; and, above all, an impure operation—complicated with loss of vitreous and remaining of lens substance within the eye.

Four cases of capsulitis, out of these 100 of extraction, presented themselves and were quite remarkable.

The first was that of a whimsical old woman, who was operated on without accident, but some cortical matter was left. The eye got a little red, but the iris was fully dilated, the pupil rather opaque. In this state she could not be induced to stay any longer in the institute. She had no pain, and thought the eye might now take care of itself at home. So she left, ten days after the extraction, with $S=\frac{1}{20}$. At home she looked after her business which had been neglected so long. Six weeks later she came again, having one-third of the anterior chamber filled with pus. The pupil was still dilated with atropine which she had constantly instilled. I applied poultices on her eye. The hypopyon diminished immediately. The peripheral zone of the dilated pupil first cleared up, *while the centre was intensely yellow, like a circumscribed corneal pustule.* In five days the hypopyon had disappeared. Shortly afterward she left the institute with a hazy pupil, but with very good prospects for further improvement.

The second case was operated on without accidents, or remaining lens matter, in a woman of sixty-seven. She experienced pain in her eye the second night, had chemosis, hyperæmia of iris, the dilated pupil was filled by a yellowish gray, wrinkled membrane, in which there were some dark, free places. These symptoms went on slightly increasing, until eleven days after the operation hypopyon appeared, the iris became somewhat swollen, and there was one filiform synechia below. The hypopyon increased for a week, but was never higher than 2 mm. Then it diminished and disappeared, twenty-four days after the operation. At its place lay upon the iris

a small, reddish, convex mass, not unlike sprouting granulations. It shrunk gradually, and the patient was dismissed fifty days after the operation, with a dense pupillary membrane, being able to count fingers near the eye. Three months afterward Professor *Becker* performed iridectomy, which brought about a very clear pupil, and already, in the course of one week, $S = \frac{1}{8}$.

The third case was a good operation in a healthy woman. Under painless chemosis and dilated pupil, the latter grew hazy, and the patient left twenty days after the operation, free from irritation, with $S = \frac{1}{60}$, and the intention of having an after-operation performed in case the pupil should not sufficiently clear up of itself.

The fourth case was a stout man of forty-nine years of age. Operation was without accident, and seemingly with a clear pupil. This latter, however, showed itself filled the next day with a considerable quantity of swollen cortical fragments and pieces of capsule. The pupil was dilated, the iris discolored. Some synechiæ and hypopyon followed. These symptoms abated rapidly, the hypopyon disappeared, the pupil remained dim when the excitable patient got mental troubles, fits of mania, and hastened home, ten days after the operation, with S about $\frac{1}{15}$, but very good prospects of a satisfactory result

The latter case may be called *capsulo-iritis*, the inflammation of the capsule being decidedly the primary affection.

Diffuse inflammatory opacity of the vitreous was observed in three cases. In the one it occurred after the extraction of a hypermature cataract, with thickening of the anterior capsule by whitish-gray and yellow (connective tissue and chalk) deposits on its posterior surface. The operation was without accident. Wound closed rapidly, no abnormality of iris and pupil, anterior chamber a long time shallow, chemotic swelling of conjunctiva, and a gray, smoky appearance of the vitreous as in acute glaucoma. No pain or uneasiness of the eye. These symptoms began the third day, increased

slightly during the first week, then decreased; so that the patient was dismissed seventeen days after the operation. The redness and conjunctival swelling had nearly entirely disappeared, but the vitreous still looked misty, and S was only $\frac{1}{10}$. No doubt it will have become perfect in a short time.

The other two cases were in both eyes of an old lady with slowly progressing cortical cataracts. The anterior capsule looked somewhat thickened by irregular deposits of inorganic and organic substance. Both operations were very smooth, but there was a slow re-establishment of the anterior chamber, chemosis and smoky turbidity of the pupillary field and vitreous. No pain, no alterations of iris. Only very slowly the conjunctival redness and swelling disappeared, and meanwhile the pupil was traversed by a thin grayish film. Thirty-four days after the operation S was $\frac{1}{10}$ in either eye. Therefore discision was performed, and the patient dismissed five days later with $S = \frac{2}{3}$ in either eye.

The trouble in the former case may be called simple *hyalitis*, that in the latter *capsulo-hyalitis*.

One *eye was lost by primary suppurative keratitis.*

The patient was a decrepit, very anxious lady, eighty years of age, and operated on during the hottest time of July. The operation could not have been smoother and more regularly peripheral and linear. The apex of the wound was $\frac{1}{2}$ mm distant from the transparent corneal margin. The day after the operation there was some mucous secretion on the lint covering the eye, slight œdematous swelling of the border of the upper lid, some redness of the conjunctiva and chemosis. The anterior chamber was filled and clear, pupil and iris entirely normal, and vision excellent. At the external corner of the wound, however, was a whitish swelling—infiltration of the lips of the wound, about one-fourth of its whole extent, the other three-fourths being perfectly smooth and well

united. The infiltration did not yet encroach upon the transparent cornea, but was entirely limited to the sclerotic at both sides of the cut. I mention expressly that no iris or any other perceptible foreign substance lay in the corner of the wound. The progress of the affection was simple. Without marked pain, the white infiltration extended gradually over the whole section, then upon the cornea, proceeding one definite step downward every day, showing a pretty sharp line of demarkation which, like in gangrene of the foot, advances a little every day. When it had reached the middle of the pupil, which was on the fifth day, the lower half of the pupil was still beautifully black and afforded the patient good sight. There was from the beginning only a very low degree of that peculiar form of striped parenchymatous keratitis which we witness as a rule after peripheral extraction. In the way just described the entire cornea was destroyed by suppurative softening, and the eye shrunk under the symptoms of panophthalmitis. The patient was dismissed twenty-four days after the operation.

If we now recapitulate the different disturbances of the healing process worth noting, as far as they have some influence on the results of the operation, we find the following:—

Six cases of *after-hæmorrhage*, five of which not interfering with a speedy and perfect healing; in one, however, aggravation took place after the patient had left the hospital, and was followed by irido-choroiditis of both eyes, in one eye most probably of a sympathetic nature.

Seven cases of *iritis*, two of them healed well and with good sight, three had occlusion of the pupil requiring a second operation for instituting an artificial pupil, and two were lost by suppurative irido-choroiditis.

Three cases of *capsulitis*, healing with imperfect sight easily improved by an after-operation.

One case of *capsulo-iritis*, with but moderately good sight requiring an after-operation to obtain full success.

One case of *exudative hyalitis*, doing well.

Two cases of *capsulo-hyalitis*, doing well also.

One case of *primary suppurative keratitis*, eye being lost.

This statement gives a comprehensive survey of the reactive processes following this method of extraction. Let us inquire in what they differ from those of the corneal extraction, in order to find out which ought to be attributed as proper to the peripheral extraction.

First we see one instance of *true corneal sloughing*, as pure, complete, and terrible as ever it can happen after the ordinary flap-extraction. The old age and the excessive summer-heat may be alleged as having been productive of this bad result, but the example shows that pure corneal sloughing is not precluded by the periphericity of the section. Nevertheless it is a very rare occurrence after the peripheric operation. Since former observations are not so conclusive of establishing the point of origin of destructive suppuration of the globe, having not, as the present ones, been made so early after the operation, we must take all the cases of suppurative panophthalmia together. Of them there were three in this third hundred of cases, a higher percentage than in the two former hundreds. Still this is much more favorable than what I have experienced in previous years by flap extraction, especially in hot summer-time.

Next comes *the reaction of the iris.* Seven cases of iritis

out of a hundred operations is decidedly less than I have ever before experienced after any method of extraction; two cases out of the seven were only low degrees, so that only five cases of severe iritis remain, two destructive, and three requiring after-operations for restoring sight. This low percentage of iritis may be accounted for by the pure and broad iridectomy, especially by taking care that before the exit of the lens no part of the iris is left in the section.

After this we observe some *reactive processes which, I suppose, are more proper to this operation than to the corneal; I mean the capsulitis, capsulo-iritis, capsulo-hyalitis, and hyalitis proper.*

The clinical features of *capsulitis* have now come sufficiently often under my notice, to enable me to give a general picture of its symptoms after the notes in this and my former reports. As to its causes, I think the extensive tearing of the capsule, especially when the latter is changed in structure, acts in favor of the production of new cellular elements within the capsule. At the height of the process there is the greatest resemblance to corneal pustule or circumscribed abscess. This collection of pus was observed in the centre of the capsule, but I am not at all certain, whether those cases where the yellow discoloration appeared at the periphery of the coloboma, and which were registered as iritis, may not have had their starting point in inflammatory reaction of the capsule. The equatorial zone of the crystalline has a greater quantity of young cellular elements, is nearer to the nutritive channels, and may therefore be supposed more liable to reactive inflammation than the centre of the

capsule. I must again pronounce, as I have already done in my first report two years ago, what a benefit it would be to remove the anterior capsule by a fair procedure. Excision will be the only way, since tearing, which now is done most extensively, and, in some cases, has the effect that part of the capsule exudes together with the cataract, is a manipulation neither so appropriate nor so safe as excision would be. Clear cuts are easily borne, as we see in the iris, but tearing and bruising are detrimental hurts to any tissue or organ. Now, when we come to the practicability of excision of the capsule, there seems to be hardly any thing else conceivable than to cut or rend the capsule by a sharp, curved needle, cystitome, or hook, then seize it with delicate forceps (rather than with a peculiar modification of the needle or hook, as I have seen several contrivances for similar purposes), draw it out, and if necessary cut it off close to the wound.

That the inflammation of the capsule may extend towards the iris and towards the vitreous seems very natural, and is proven by direct observation.

Another group of consequences of this operation are deeper-seated affections; those of the ciliary processes, choroid, vitreous, and, secondarily, the retina. Hæmorrhage and *primary opacity in the vitreous* are rather frequent in this mode of operating, although I have noted, this time, but one case of hyalitis. This was, however, such a marked one, that it could not have been overlooked. Had I turned my attention more particularly to these deeper-seated changes, I should most probably have noted more of them. Their origin certainly lies in the proximity of the section to

the ciliary body and vitreous. The injury creates hyperæmia and its consequences, exudation and extravasation. These alone will pass away without damaging the eye, but when they are added to similar conditions in the membranes bordering the anterior chamber, they may make a total of inflammatory reaction, the consequences of which are commensurate with the number and dignity of the parts affected. That the involuntary or voluntary rupture of the hyaloid membrane, with protrusion of the vitreous into the anterior chamber or outside the eye, is another addition to the injuries inflicted on the eye by the operation for cataract, is self-evident. Not knowing beforehand what resistance each individual eye is capable of presenting to the unavoidable hurts of the operation, I do not feel justified to increase them voluntarily by another one (as *Hasner* does in his puncture of the hyaloid fossa); and, as everybody, I consider involuntary protrusion of vitreous to be an unfavorable complication.

Although these remarks have become somewhat lengthened, against my intention, I do not like to curtail them, since they are all based upon positive observation, and, as to me, may serve to others to understand more thoroughly the dangers and requirements connected with all the steps of this admirable, though complicated operation. The deeper our understanding is, the more to the purpose will be the different acts of the whole procedure; and I do not think it impossible that, by knowledge and practice, we may yet be able to perform extraction of cataract with the same degree of safety as the operations for artificial pupil.

TIME OF HEALING.

The average duration of the patients' stay in the institute was $14\frac{11}{100}$ days. They were dismissed as soon as the reaction from the operation had subsided, and the process of further clearing up of the eye and consolidation of the wound was judged unendangered by the usual external influences of light, locomotion, &c. The following data give a general insight into the time of healing. Out of the one hundred patients, fourteen were dismissed from the seventh to the ninth day (inclusively) after the operation, forty-six from the tenth to the fourteenth incl., twenty-nine from the fifteenth to the twenty-first incl., and ten from the twenty-second to the fiftieth.

The usual course of healing, therefore, did not even last a fortnight, whilst a protracted healing, from three to seven weeks, occurred in ten per cent., the greater part of which were dismissed during the fourth week.

RESULTS AS TO VISUAL ACUTENESS.

The visual acuteness of all the cases was determined the day before dismissal, that is, at the earliest possible date. This I beg the reader to take into consideration when judging of the results obtained. The given figures are primary results with a good chance of spontaneous improvement in all. In many cases I performed discision of pupillary opacities at an early period after the extraction, but never before the inflammatory reaction had subsided, the patient being in such a state in which he would have been dismissed

but for a secondary operation. Of this early discision I intend to speak at another time; I will only mention here, that none of the patients lost any thing by, or underwent a considerable degree of inflammation after it. Almost all cases healed quickly (commonly in five days), and gained very much by the operation, so, for instance, $S = \frac{1}{10}$ was nearly always raised to $S = \frac{1}{5}$ or $\frac{1}{4}$. The following statement of visual results is made *before a secondary operation*, and represents the visual power at a period when the patient's eye has not yet entirely recovered from the operation, but is only on a sure way to do so. The determination was made by looking at a distance in a moderately clear room in using Snellen's test type.

Number of Eyes.	Obtained Acuteness of Vision.
1	$\frac{3}{4}$
4	$\frac{1}{2}$
4	$\frac{2}{5}$
8	$\frac{1}{3}$
12	$\frac{2}{7}$
21	$\frac{1}{4}$
7	$\frac{1}{5}$
6	$\frac{1}{6}$
2	$\frac{1}{7}$
4	$\frac{1}{8}$
14	$\frac{1}{10}$
3	$\frac{1}{12}$
1	$\frac{1}{15}$
4	$\frac{1}{20}$
1	$\frac{1}{40}$
1	$\frac{1}{60}$
1	$\frac{1}{200}$
3	$\frac{1}{\infty}$*
3	0

* $\frac{1}{\infty}$ means curable blindness, or good perception of light in simple occlusion of the pupil. 0 means incurable blindness, with or without perception of light.

If we make larger groups, and consider all eyes, the sight of which is destroyed, as losses or failures, all those with S beneath $\frac{1}{10}$ as imperfect results, and those with S $=$ $\frac{1}{10}$ or more as perfect results, we have losses, 3; imperfect results, 15; perfect results, 82.

Most of the imperfect results have been converted by after-operations into perfect ones, all (except two with deep-seated complications) were susceptible of becoming good results. Thus, I may *sum up the ultimate result*, that 3 *per cent. of loss*, 6 *per cent. of imperfect, and* 91 *per cent. of good success* were obtained.

CASE OF ORBITAL CANCROID WITH HISTOLOGICAL PECULIARITIES.

By H. KNAPP.

(See Tab. I. Figs. 1 and 2.)

MARG. MUENCH, sixty-two years of age, of Waldmichelbach, near Heidelberg, presented herself at my clinic, 7th of May, 1868, seeking relief for an orbital tumor. Besides this, she had at the left side of her nose a round, reddish lump, the size of a hazel-nut, slightly projecting over the skin which itself was involved in it. The neoplasma had existed for four years. I considered it to be a *common epithelioma*, extirpated it, and found the diagnosis confirmed by the histological examination. The wound healed well.

Six months previously, the woman had noticed at the inner canthus of the right eye, a swelling which, since that time, had considerably increased. It had the size of a bean, was hard to the touch, free from pain, projecting over the inner canthus of the lids, movable with the skin, which was involved in it, and exulcerated to a very small extent on its top. In the immediate neighborhood were different reddish nodules, the size of a pea, embedded in the integu-

ment of both lids. On exploring the orbital cavity with my finger, I felt that the above-described tumor continued backward, as an oval hard mass along the inner wall of the orbit, to which it was firmly attached, its basis being quite immovable. Small nodules were visible through the conjunctiva of the lids.

I believed the growth to be a cancroid similar to that on the nose, and thought an extensive extirpation indicated, since the woman was in good general health, and the eyeball itself yet unaffected. Though the comparatively rapid increase of the growth, its penetration into the depth of the orbit, and the immovableness of its basis on the inner wall of the latter did not seem to warrant a favorable prognosis, they were, on the other hand, good reasons why the complete removal of the pseudoplasma should at once be undertaken, lest deferring might render it impossible.

I performed the operation in the following way. From the root of the nose (Fig. 1, *a*) I made an incision through the skin downward till *b*, and upward till *c*. Then I introduced one of the blades of a pair of scissors into the conjunctival sac, first under the lower lid (at *o*), afterward under the upper (at *e*), and cut through the whole thickness of the lids, at right angles to their fissure. This done, I prolonged these last cut lines as far as the ends *b* and *c* of the two first incisions. In this way I had confined in a somewhat rhomboidal space all the suspicious swellings. The incision through the skin in no place approached any of the tumors nearer than three millimetres. The horizontal length of the wound reached from the root of the nose to the middle of

the lids, so that the inner half of either lid, and the skin of the right side of the nose, nearly as far as its back, had been taken away. I then dissected the parts confined in this space as deeply as I could feel any hardness in the orbit. The tumor near the nose reached over half an inch backward, and was closely united with the periosteum. To secure the total removal of the foreign growth as well as possible, I took away a considerable part of the periosteum of the inner orbital wall, and even a small piece of the bone, which seemed to be a little softened. The conjunctiva of both lids was removed with the tumor as far backward as the line of its inversion on the globe, thus leaving the latter covered by nothing but its own mucous membrane. The muscles of the eye had not been touched, nor any important part within the orbit injured, the lachrymal sac alone having been removed, together with the growth.

There was no considerable bleeding during the operation, and no vessel required tying or twisting.

I immediately went to work to cover the defect by a plastic operation, the plan of which will be understood by referring to Figs. 1 and 2. The object was to replace the deficient parts of both lids, in order to protect the globe. I formed two quadrangular lobes of skin, one superiorly on the glabella (Fig. 1, *a d f c*), the other inferiorly on the cheek and temple (Tab. I., Fig. 1, *o g h b*). After having dissected them to their bases and stopped the bleeding, I united the line *a c* with the line *e c* by sutures, so that part of the lower margin *a d* replaced the removed portion of the upper lid.

In a similar way the flap *g o b h* was transferred toward

the point *a'*, the skin around which had been previously dissected from its basis. The remaining outer half of the lower lid was in this way to become its inner half. I united first the lines *o b* and *a' b* with each other, then the inferior border of the superior flap with the adjoining skin; thus the line of union *a' d'*, Fig. 2, was formed. At last I united, by sutures, the outer portion (*g'*) of the superior border of the inferior flap with the adjacent skin above (Tab. I., Fig. 2, *g'*).

In this manner I succeeded to complete the two eyelids, and obtain a pretty regular palpebral fissure. Moreover, the upper lid could be fairly raised, the tendon of the levator muscle having lost nothing but its inner expanse.

The wound healed beautifully. A small part of the lower inner section only (*a' o*, Fig. 2) gave way, which produced a slight eversion of the lower lid near the inner canthus. The patient was dismissed from the hospital nine days after the operation. She had preserved a healthy eye protected by movable lids. Five months later, when I left Heidelberg, the eye and lids were still in the same very satisfactory state. The palpebral aperture could be opened and shut without trouble, and the cicatricial tissue at the inner side of the eyeball did not impede the free movements of the latter. No trace of any relapse of the tumor was observable.

Although the foregoing account may not be found destitute of clinical interest, this, by itself, would scarcely have induced me to publish the case. The *microscopic examination* of the specimen, made by my assistant surgeon, Dr. *Fr.*

Pagenstecher, revealed such a peculiar composition of the growth, as to give an additional scientific value to this case. The morbid conditions of the tumor being invested with a high pathological interest concerning the question of carcinomatous disease in general, Dr. *Pagenstecher* thought fit to give, in Virchow's Archives of Pathological Anatomy, vol. xlv., pp. 490–500, a more detailed anatomical description of the specimen than our space would allow. This description is illustrated by two lithographic plates. I shall, therefore, give a brief statement only of the results of this research, derived from Dr. *Pagenstecher's* microscopical preparations, which I did not neglect to examine carefully myself.

The *epidermoid layer* of the skin was perfectly normal, not at all thickened, nor sending any prolongations into the layers of the corion. Its appendixes, the hair-follicles, the sudoriferous, meibomian, and sebaceous glands behaved normal too; the same can be said of the muscles, blood-vessels, and nerves; but a very conspicuous *system of canals* running through the connective tissue was brought to view. They were forming an irregular net-work, with frequent anastomoses in broad and sinuous nodal points, winding in all directions through the corion, entering into the vascular papillæ, and penetrating backward into the cellular tissue of the orbit. The average thickness of the utricles is 14μ [= 0,014 millimetres]. They possessed no special walls, but were well defined towards the adjoining tissue. Their calibre is filled with cells, colloid globules, and molecular masses. Some of the cells, especially those lying in the broad nodal sinuses, are very flat, their large nuclei and nu-

cleoli very distinct, not so their walls. The same arrangement of sinuous, winding canals, filled with flat and sometimes cylindrical cells, embedded in a loose connective tissue, was found in the orbital portion of the tumor. Numerous lymphoid cells are dispersed through the connective tissue, principally around the described tortuous canals and the blood-vessels. The smaller sinuous canals, filled with cells, communicate with larger ones that are mostly empty. Some of these are replete with *finely striated and granular masses* which do not themselves enclose any cell or colloid globules.

This system is sinuous canals, bearing the greatest resemblance with lymph-vessels, must indeed be considered identical with the latter, since nothing else could account for their existence. *The last-mentioned striated and granular masses*, plugging in different places the larger canals, *were fibrinous coagulations*, i. e., *lymph-thromboses.* The accumulation of epithelioid cells, filling all the smaller and some of the larger branches of the lymph-vessels, was occasioned probably by a proliferation of the epithelial cells lining the inner wall of the lymph-vessels. The colloid globules are degenerated epithelioid cells. In a very few instances Dr. *Pagenstecher* saw similar canals, filled with the same contents, surrounding the cutaneous *nerves* of this specimen, and anastomosing with the above-described system of degenerated lymphatic vessels.

He thinks that they are an analogon to the lymphatic sheaths around the blood-vessels described by Prof. *W. His* and others. In no part of the present specimen, however,

he found these perivascular lymphatic sheaths degenerated.

The foregoing explanation of this morbid growth has first been advanced by Prof. *V. Recklinghausen*, who found two similar specimens only, described by his assistant, Dr. *Koester*. Further investigations are needed to clear up the important question, whether the lymph-vessels are liable to be the origin of carcinomatous growths, and, if so, what is the rate of frequency of this occurrence. For the surgeon many important considerations arise from these observations. Is it possible to diagnosticate this peculiar form of cancer? What is its prognosis with or without extirpation? It seems that our specimen, and the two of Prof. *Recklinghausen*, are to be classified among those tumors which have been described under the names of *Cylindroma* and *Utricular Sarcoma*. The orbit, and especially the inner canthus of the eyelids, seem to be a favorite seat of these growths, since a comparatively large number of them have been found in this region. They all displayed a very pernicious progress, and invariably recurred after extirpation, a fact which may be accounted for by the insidious creeping of the pseudoplasma along the lymph-vessels, without producing circumscribed swellings at first. What does enable the surgeon to recognize the finest and last projections of such an evil? How far away from the tumor must he draw the demarkation-line of the tissue to be removed? The old rule of operative surgery, to take away, in malignant growths, as much as possible of the seemingly healthy surrounding tissue, ought to be regarded to the greatest extent, whenever

there is reason for supposing a growth to be a cylindroma, or of the nature of the case here described. The latter will be carefully watched, and if any thing of its further course should prove interesting, I shall not fail to report it.

Five months later, that is ten months after the operation, I was informed that no change had taken place in the patient's eye, nor in her general health, especially no local recurrence could be detected.

ALTERATIONS OF TASTE AND SENSIBILITY IN THE TONGUE BY THE APPLICATION OF AN ARTIFICIAL TYMPANUM IN A CASE OF LARGE PERFORATIONS IN BOTH MEMBRANÆ TYMPANI.

By S. MOOS M. D.,

Professor at the University of Heidelberg. Translated by H. Knapp.

In the Centralblatt für die Med. Wissenschaften No. 46, 1867, the following notice was given by me :—

"By the application of the artificial membrana tympani—Toynbee's complete plate—alterations of taste and feeling in the anterior half of the tongue may occur under certain conditions. These alterations are to be considered as symptoms of pressure, caused by the contact of the *outer* surface of the artificial membrane with the *inner* surface of the preserved upper remainder of the natural tympanum, resp. with the chorda tympani lying in this region."

In the following lines I shall communicate the particulars of this observation, and endeavor to give an explanation of the observed facts.

The case referred to is a lady, twenty-seven years of age, who suffered since her childhood from scrofula and discharge of both ears. Another cause of her aural disease was unknown to her. The latter had pursued till now an entirely chronic course. It was painless, with increasing deafness, and a very copious discharge, which was sometimes greatly offensive, from both ears. After stronger bodily exertions, now and then after mental excitement, the patient suffers from pulsating noises, especially in her left ear, while she feels free from any other subjective auditory sensation. Besides that, she complains of dullness and heaviness in her head, exacerbating, from time to time, to real headache, especially on her left side. Lately a high degree of deafness condemned her to a solitude which greatly depressed her mind. The examination revealed the following conditions, very similar on both sides.

Both external meatus very wide, rather straight, partly excoriated by the copious purulent discharge, especially along the lower wall; both membranæ tympani destroyed, with the exception of their upper and posterior marginal portions, which appeared reddish-gray and thickened; in the tympanic cavities a considerable quantity of fluid pus. When the latter was removed, the mucous membrane appeared like a luxuriously granulating conjunctiva. Nothing could be seen of the ossicles but the thickened short process, and this only indistinctly, on account of the swelled and opaque layers of the tympanum by which it was enveloped. Both Eustachian tubes were at first wholly impervious to inflated air. The patient behaved rather awkwardly at the beginning, and the air entered with difficulty and only through the catheter into the tympanic cavity. The tubes were rendered permeable for Politzer's method by repeated application of the catheter. Hearing-distance for loud voice direct on the right side one pace on the left; a watch was heard only when brought in contact with the right ear, instead of at thirty feet distance; on the left it was heard at three inches distance. Conduction of sound

through the bones of the skull preserved. The results of the examination with a tuning-fork were not precise enough for definite conclusions. The experiment with a double otoscope manifested only a weak transmission of sound from the patient's left ear to the ear of the surgeon. It was impossible to remove the pus collected in both ears, since each time that I tried to do it (even with the utmost precaution) distressing giddiness, vomiting, and fainting ensued.*

The cleaning of the hearing organ was effected by myself and the patient by means of a delicate painter's brush, which was repeatedly moistened with tepid water. The following *indications* for the treatment were derived from the above-mentioned conditions.

1. To clean the ears frequently after the method here described.

2. To remove the obstructions of the Eustachian tubes by means of the catheter, &c.

3. To combat the hyperæmia and swelling of the mucous membrane lining the tympanic cavity by alternate applications of different astringents. I employed sulphate of zinc, alum, and nitrate of silver. The latter was brought every now and then upon the morbid mucosa of the tympanic cavity through the ear speculum.

4. To try to improve the patient's hearing by an artificial membrana tympani, I could satisfy myself of their beneficial effects on both sides already during the next day.

* The same accidents, occurring instantaneously, I observed in a young man, fifteen years of age, when I was examining with a bent probe the motion of a polypus seated in the superior and posterior part of the tympanic cavity. The plate of the stapes, in this case, had probably been rapidly and vehemently forced into the vestibulum. Of late, *Czermak* has made the observation, in repeating the well-known experiments of Flourens, that vomiting followed after the section of the semicircular canals (Fenaische Zeitschrift für Medicin, vol. iii., p. 101.)

The treatment pursued in accordance with the three first indications improved the patient's hearing very much. Whilst a watch of thirty feet hearing-distance could be heard by the right ear at a distance of two inches, by the left at a distance of three feet, it was heard, with an artificial tympanum, at a distance of eighteen inches by the right ear, and at a distance of six to seven feet by the left. The patient felt very happy at being now able to understand ordinary conversation without any trouble. She made use of artificial tympanums alternately in one ear alone or in both together, and had soon acquired skill enough to introduce them herself. At the beginning I inserted large tympanums (of 12 mm. diameter) to fit into the large perforations, in spite of their tilting over at every application. Her hearing was most improved by their employment. But at length they caused strong irritation of the ears, so that she was obliged to replace them by smaller ones (of 9 mm. diameter), the plate of which was thinner.

The improvement of hearing proved most remarkable when the artificial membrane was introduced further inward than the remainder of the natural tympanum, and its outer surface was applied against the inner surface of the latter. With the ear speculum these conditions could be easily verified, and the patient very soon felt the necessity of applying it in this way, which she learned to do by trying until the situation described was attained.

Whether she had been successful with the manipulations or not she recognized by the good perception of her own voice and by a loud murmur; the latter symptom is accounted for by the increase of intra-auricular pressure caused by the instrument.

Towards the end of the treatment she directed my attention to peculiar phenomena which, indeed, she had already perceived at the beginning of the treatment, but which had lost their mere accidental character only after a longer period of careful observation. She related them with the following words:—

"After the insertion of the apparatus a feeling of insensibility began to take place at the posterior part of my tongue, and I had the sensation as if all was swollen, so that the tongue appeared very heavy in speaking. I thought there was some change of the tongue visible, but could see nothing particular when looking in a looking-glass. This sensation lasted during the whole day, as long as I kept the instrument within my ear, and even a full hour after its removal. All solid food appeared to be very smooth, without any roughness, even hard bread-crusts felt as if I touched with the tongue at the even surface of a piece of ice.

"Fluid substances of most different kind—wine, beer, sweet coffee, acid (she used to eat much salad at that time)—all appeared tasteless, I only had the taste of them in swallowing.

"The jaws, especially the left one, were somewhat heavy in speaking, as if a stiffness existed in them; at the same time I felt a continuous murmur in both ears, but my hearing was very good. The whole accident began half an hour after the application of the small apparatus, and I observed it about four to five times in four weeks, during which time I wore the artificial tympanum. When I wore the latter only on one side, the peculiar symptom was present only on that side, and with large apparatus it occurred more easily than with the smaller ones."

Two days before her departure I asked her whether she still felt that symptom, upon which she answered in the negative, adding, "when I now wear the apparatus in my ears I have a sick taste as if I were ill."

Unhappily I could not avail myself any longer of Professor *Helmholtz's* advice, to whom I communicated this observation, namely, to make experiments with powdered substances. Nevertheless I feel justified in believing the

minutely described phenomena of our patient as a valuable contribution to the physiology of taste.

EPICRISIS.

From our patient's communications it follows undoubtedly that, by wearing the artificial tympanum, she had repeatedly suffered from an anomaly of taste and feeling in the anterior half of the tongue. As long as the substances mentioned above had not been actually swallowed, they were indifferent to her organ of taste. We need not inquire here whether, apart from the root of the tongue, the anterior surface of the soft palate, or even its posterior surface, as well as the tonsils and the pharynx, participate in the perception of taste during deglutition. It is sufficient to state, in general, that the perception of taste existed as far as it could be attributed to an artificial anomaly of conductibility in those nerve-fibres which run into the tongue through the chorda tympani. Not only this anomaly of *taste* is important, but also that of *sensibility* in the tongue. If we make the concession that a complete anæsthesia of the anterior part of the tongue did not exist, then the sensibility of this region was certainly very considerably diminished. All that the patient ate appeared to her very smooth; for instance, hard bread-crusts were like pieces of ice. In general, we may, from this case, draw the conclusion that the chorda tympani collects not only fibres of taste, but also sensitive ones, a fact which is in accordance with the results of experimental physiology.

We have accounted for the named anomalies by the pressure of the artificial membrane upon the chorda tympani. Evidently a certain interval of time was necessary till the pressure, respecting the interruption of conductibility in the nerve-fibres concerned was complete, for the anomalies commonly manifested themselves only half an hour after the application of the instruments. That, on the other hand, the effects of pressure have been considerable, follows from the fact that the anomalies of taste and feeling in the tongue continued an hour after the removal of the instruments.

This observation has some analogy with the effects of the artificial tympanum on the restoration of the last conduction of sound through the osseous parts. In the successful instances of this experiment, the conduction of sound continues for a shorter or longer period after the instrument is withdrawn. [Compare my communications in "Archiv für Ohrenheilkunde," vol. i., part 2.]

The effect was uni- or bi-lateral, as the artificial tympanum had been applied on one side only or on both. It also was more intense after the introduction of larger and thicker instruments than after that of smaller and thinner ones; the pressure from the former being probably greater than that from the latter. The non-occurrence of the mentioned anomalies during the latest period of treatment, could not be dependent on a softening of the plates of the artificial tympanic membranes by their use, which rendered them incapable of exercising a sufficient pressure; for they proved efficient enough to produce such a pressure as was required for the improvement of hearing. Moreover, I did not suc-

ceed in reproducing the described phenomena by the use of new artificial membranes. Perhaps the chorda tympani had been displaced by the repeated use of these instruments, so that it was no longer, or not closely enough, in contact with them to cause the full series of symptoms as at the beginning. Perhaps, also, the nerves of the chorda had been blunted by the repeated pressure upon them. The perversity of taste and feeling which the patient lately alleged, may have resulted from some pathological change in the nerves hemselves, occasioned by their frequent contact with the foreign body. The difficulty of speech may be consequent to the diminution of sensibility in a similar manner, as we often find the motion of an organ impeded when its sensibility is reduced.

Later news which I received from the patient stated that her hearing continued to remain materially improved, while she observed only temporarily and in longer intervals the other anomalies above described. Once only the instrument reproduced the tastelessness and insensibility in the tongue with its former intensity, and that was after it had been out of use for some length of time.

APPENDIX.

Our contribution refers to a subject on which there is still much controversy. Professor Schiff, of Florence, who, as far as I know, has made on it the most recent inquiries, published, in Moleschott's "Untersuchungen," vol. x., pp. 406–422, experimental results contradictory to those of Lusanna and Jnzani (Observations et Expé-

riences sur les Nerfs du Goût. Gazette Méd., 1864, p. 403), and to those of NEUMANN (Partieller Verlust des Geschmackssinns als Folge einer Otitis interna. Königsberger Medic. Jahrbücher, vol. iv., part 2, p. 340, and Moos' Klinik der Ohrenkrankheiten, pp. 244, 245). According to SCHIFF the second branch of the fifth nerve alone conveys all the fibres of taste, but they run for a short distance with the facial nerve; only part of them are given off to the lingual nerve by other anastomoses, as is especially the case in the dog and cat.

ISOLATED RUPTURE OF THE CHOROID, RESULTING FROM CONCUSSION OF THE EYEBALL.

By H. KNAPP.

(See Tab. I., Figs 3 to 4 A., and Tab. II., Figs. 4 B. to 9.)

THE bad effects of concussions of the eyeball have, undoubtedly, been noticed as long as there have been careful observers of eye diseases. Not a small number of cases are on record in which sight was impaired or lost after an injury to the eyeball or its surroundings, without any perceptible lesion of its tunics. Very different explanations have been given of these distressing consequences, arising from hurts apparently insignificant. The nervous system in general, the vaso-motor nerves in particular, the retina and optic nerve, it is alleged, have all suffered from injury and undergone minute molecular changes. All this is no more than conjecture. Whenever the blow has hit the orbital borders at the same time as the eyeball, which in most cases will have been inevitable, a fracture or fissure of some bony part at the base of the skull has been suspected. The broken bone may have lacerated or com-

pressed the optic nerve or the chiasma nn. opt.; or else the ensuing hæmorrhage may have made its way into the loose tissue, between the internal and external sheath of the optic nerve, and diminished or destroyed by pressure the conductibility of the nervous fibres; or the resulting inflammatory exudation following the injury may have involved the optic nerve or the chiasma. These assertions are not entirely hypothetical, but have, in rare instances, been demonstrated by post-mortem examinations.

More frequently, however, the ophthalmoscope reveals that the cause of the impairment of vision after concussion of the eyeball is a *rupture of the choroid*, rarely combined with laceration or detachment of the retina. A great many observations regarding concussion of the eyeball made before the discovery of the OS have now lost their value. True it is, indeed, that blindness or impairment of vision has been observed after a blow on the eye, in cases in which neither the external nor internal coats presented any change even upon the closest scrutiny of competent ophthalmoscopists. As far, however, as my own personal experience goes, such cases must be extremely rare. I do not, at this moment, recollect one single case of concussion with noticeable impairment of vision, where I could not see some definite change within the eye, or where there was not a combination with such cerebral symptoms as to indicate a deeper-seated lesion.

Since isolated choroidal rupture has not yet been made the subject of a general description, except briefly in some recent text-books, I will insert here a tabular statement of

the cases of this lesion recorded up to the present day. To these I shall add eight cases from my own observation, of which I possess drawings. The description will be inserted among the general remarks on the subject; at such places as their peculiar features serve to illustrate.

Tabular Statement of the Cases of Isolated Traumatic Ruptures

No.	Reference.	Year.	Nature of Injury.	Time after when first examined
1.	Von *Graefe.* Arch. f. Ophth., I., 1, p. 402.	1854.	Violent injury occasioning fracture of os nasi, contusion of lids, and impairment of vision. Central scotoma Large type made out with difficulty.	Some weeks.
2.	Von *Graefe.* Ibidem.	1854.	Injury.	Long time.
3.	Von *Ammon.* Arch. f. Ophth., I., 2, p. 124.	1855.	Suicide by d'scharging a musket, loaded with water, into his mouth. Death immediate.	*Necropsy* four hours later.
4.	*Streatfeild.* Ophthal. Hospit. Rep. II., p. 241.	1860.	Violent blow with a shovel on the temporal side of the orbit.	Six months.

of the Choroid as recorded up to the Present Time.

SYMPTOMS.—COURSE.—RESULTS.
Choroidal hæmorrhage in vicinity of opt. disc, disappearing in the course of some weeks. In its place a shining, white streak, with sharply-defined dark edges, encompassing a rhomboidal space around the opt. disc. Retinal vessels could be traced over the rupture, *one branch only was interrupted.* Six months after first examination the same appearance of fundus. S as in the beginning.
Great amblyopia, strabismus internus. A very bright stripe running from the opt. d. *inward* through the fundus. $\frac{1}{2}$ D broad, 5 D long. Edges rusty brown. Retinal vessels branching over the white stripe.
Above the yellow spot the retina somewhat raised in a form like an elbow and directed outward. Just behind it the choroid was lacerated, showing a wedge-shaped rent some lines in length. *The edges of the rent not gaping.* No extravasation of blood other than some small streaks between choroid and sclerotic.
$S = \frac{1}{200}$. Deep glaucomatous cup. Above the opt. disc, two marks concentric with its margin; the nearer and larger one having a curve of about a quarter of a circle. Vision had improved after a short stay in the hospital.

Tubular Statement of the Cases of Isolated Traumatic Ruptures

No.	Reference.	Year.	Nature of Injury.	Time after, &c.
5.	*Frank.* Ophthal. Hospit. Rep., III., p. 84.	1860.	Blow on right supra-orbital region.	Eleven years.
6.	*Saemisch.* Zehender's Angenheilkunde, p. 751. (With a chromo-lithograph.)	1864.	A piece of wood struck the eye.	One week.
7.	*Saemisch.* Ibidem, p. 752.	1864.	Piece of wood thrust against the eye.	

SYMPTOMS.—COURSE.—RESULTS.

Some years after the hurt the patient was able to read the middle-sized print of the attestation paper for the military service. At the time of the examination opt. disc whiter and flatter than natural; arteries contracted; retina slightly hazy; a gray patch below the opt. d.; Mac. lut. surrounded by diffusely infiltrated retina. From the opt. d. start two white, freckled, sharply-defined bands, the one upward and inward to the limits of the fundus oc., visible through the ophthalmoscope. The retinal vessels cross it, and the upper border is skirted by black pigment. The adjacent choroid studded with white and black specks. The other band runs upward and outward, has the same character as the first, and is surrounded toward the periphery by a perfect spray of choroid alternations. The sight of the eye was reduced to the perception of the strongest light only. Strabismus had been developed. *Frank* says that there can be no doubt that the white bands represent cicatrices after isolated rupture of the choroid. The diffuse retino-choroiditic changes are the result of the former lesion.

Mydriasis of middle degree. Media transparent. Three curved, white streaks, the one between opt. disc and yell. spot, the two others beyond the latter; all slightly concave toward the opt. disc. Some hæmorrhagic spots. Central $S = \frac{1}{6}$. Central scotoma corresponding to the largest of the streaks. Gradual absorption of the effused blood. Ten weeks later, streaks in the same condition as on the beginning. $S = 1$. Scotoma disappeared.

On the outer side of the opt. papilla, a slightly concave, vertical stripe, its upper end dividing into two branches. On the mac. lut., a vertical stripe of 2 D in length. Retina not torn. Vision remained impaired after cicatrisation of choroidal rents.

Tabular Statement of the Cases of Isolated Traumatic Ruptures

No.	Reference.	Year.	Nature of Injury.	Time, &c.
8.	*Schweigger.* Lectures on the Ophthalmoscope. Berlin.	1864.	Contusion of sclerotic by discharge of small shot.	
9.	*Haase.* Zehender's Klinsische Monatsblätter. 1866, p. 255.	1866.	Violent blow on the eye from a foreign body.	Soon afterward.
10.	*Saemisch.* Zehender's Klin. Mon., 1866, p. 111.	1866.	Piece of wood flew against the eye.	A few days.

Through the ophthalmoscope sclerotic denuded appearing as a bright speck surrounded with black pigment.

Lids much swollen, the upper one lacerated; lower orbital margin fractured; great chemosis, rendering an examination of the eyeball impossible. A week afterward swelling considerably decreased, iris tremulous, *lens dislocated* downward and outward. Optic disc somewhat veiled; toward the yellow spot a crescent-shaped, vertical streak at whose extremities two smaller excentric ones. Retinal vessels unchanged. Inconsiderable hæmorrhage. Scotoma inward (?) and upward. Four months later, streaks as before, skirted now with black pigment. Scotoma stationary. $S = \frac{1}{20}$.

The injury was followed by great pain, swelling of the lids, and loss of sight. Subconjunctival injection. Tn. No lesion of the external tunics; anterior chamber half filled with blood; pupils dilated, immovable; S reduced to mere perception of light, and lost in the inner half of F. In the course of five weeks the blood in the anterior chamber was absorbed, lens healthy, some blood in the vitreous. At the background two small, whitish-yellow vertical streaks, the one between yellow spot and opt. disc slightly concave toward the latter, the other one, beyond and near the yellow spot, surrounded by bloody specks. Retina uninjured, its vessels running over the streaks. Sight improved to the capacity of counting fingers at six feet distance. Seven weeks after the injury I 2 was read with ease, but some weeks later the central S again diminished (the result of retinal changes during the process of cicatrisation of choroid). Dark specks at the borders of choroidal ruptures. Some months later central $S = \frac{1}{200}$. *Small detachment of retina* in region of yellow spot. Ultimately $S = \frac{1}{60}$; detachment of retina as before; excentric S normal; no metamorphopsia.

Tabular Statement of the Cases of Isolated Traumatic Ruptures

No.	Reference.	Year.	Nature of Injury.	Time, &c.
11.	*Stellwag.* Diseases of the Eye, translation into English, p. 227, with a chromo-lithograph. Fig. O.	1867.		
12.	*Saemisch.* Zehender's Klin. Mon., 1867, p. 31.	1867.	A thong of a balance-wheel struck the left side of his face without hurting the eye apparently.	Twenty-three days.
13.	*H. Wilson.*	1868.	Blow.	Some months.
14.	*Mauthner.* Ophthalmoscopie Wien., p. 446.	1868.	Unknown.	A long time.

SYMPTOMS.—COURSE.—RESULTS.

In the region of the yellow spot large rent dividing above and below into two serrations. Two smaller streaks beyond the yellow spot. Retinal vessels running across the streaks.

Soon after the injury suggilation of lids and impairment of S. At the first examination nothing abnormal externally on the globe. Slight diffuse opacity and blood coagula in vitreous. Opt. disc and posterior part of background normal. Downward and *beyond the equator* circular detachment of retina = $\frac{1}{3}$ D in diameter. Ecchymosis and several ruptures of retina in the same region; two small ruptures of the choroid besides; all best recognizable as such by the binocular ophthalmoscope. All the lesions were at the limits of the fundus visible through the ophthalmoscope after dilatation of the pupil with atropine. Two months later S nearly normal. Defect of F persisting.

Two crescent-shaped white stripes, one above, one below the opt. d.; nearly concentric with the circumference of the latter. Some pigment spots within the white stripes; retinal vessels branching over the latter. A third smaller one beneath the lower stripe. Distance from the opt. d. margin of the upper larger stripe = $\frac{3}{4}$ D, breadth $\frac{1}{2}$ D, length 5 D.

Vertical white streak, skirted with black pigment, on the external side of the optic papilla; $\frac{1}{2}$ D in breadth, 4 D in length.

Tabular Statement of the Cases of Isolated Traumatic Ruptures

No.	Reference.	Year.	Nature of Injury.	Time, &c.
15.	*Mauthner.* Ibidem.	1868.	Blow with the fist.	Seventeen days.
16.	*Mauthner.* Ibidem.	1868.	Blow on the external part of the globe with the handle of a shovel.	A short time.
17.	*Mauthner.* Ibidem.	1868.	Stroke from a hoof of a horse on orbital region.	Three months.

SYMPTOMS.—COURSE.—RESULTS.

No visual defect. Refracting media perfectly transparent. Slight ecchymosis on the background. $\frac{1}{2}$ D above the opt. d., a choroidal rent running horizontally outward as far as the yellow spot, dividing into two branches in its inward prolongation, reuniting and curving downward at the inner side of the opt. d. On the outer lower side is a "counter fissure" turning its concavity toward the opt. disc. Retina uninjured, slightly troubled. Patient withdrew from observation some days later.

$S=\frac{20}{70}$. Media clear. On the outer and lower side of the opt. disc, a light-yellow curve, $1\frac{1}{2}$ D in length, concentric with the margin of the opt. disc, and 1 D distant from it. A great many fine, light lines radiated from the borders of the fissure into the choroidal tissue. Below the external border a hæmorrhagic spot. Retina intact; its vessels branching free over the rent.

One large *horizontal* rent in choroid, 2 D below the opt. disc. Large retinal vessels crossing it.*

* Besides these seventeen cases two others are described by *Hirschler*. Wiener Medic. Wochenschrifh, 1866, Nos. 91, 92, which I was unable to consult, making a total of nineteen cases on record.

Among about 18,000 cases of eye diseases which came under my observation, I met with and diagnosticated, beyond the possibility of doubt, more than one dozen of isolated ruptures of the choroid after a hurt on the eyeball; but I feel inclined to believe that a great many more cases which are reported in my journals under different names, such as traumatic intraocular hæmorrhage, traumatic iritis and iridochoroiditis, ought to have been classified under the head of choroidal ruptures.

The following observation may prove this assertion:—

Alfred Edwards, 14 years old, of New York, received on the 9th of July, 1868, while playing with his fellow-students at an educational institution in Heidelberg, a blow directly on the front of the eye. He did not experience any great pain at first, nor perceive any trouble in the eye until four days later, when he came to consult me, complaining that *his sight* was rather worse than immediately after the blow; moreover, his eye had become painful and red. I found subconjunctival injection around the cornea, the iris discolored with a greenish-yellow tint, pupil much dilated and immovable, no trace of an external lesion from the injury, movement of eyeball free, no protrusion or any abnormal external appearance, the eyelids exhibited no symptom of injury, and the brain was entirely unaffected. Sight was $\frac{1}{5}$ in the centre of F, and correspondingly diminished in the periphery. Accommodation paralyzed. The refracting media appeared turbid, so that the background of the eye was seen as through a mist; its principal details, however, could be distinguished. The optic papilla was unusually red, and the larger retinal veins thicker and more tortuous than in the other eye; the retinal tissue itself appeared swollen and diffusely opaque. No details of the choroid could be recognized, on account of the

general haziness lying over the fundus, this being, as I noticed, densest in the vicinity of the od. My opinion was that I had to deal with a case of *traumatic iridochoroiditis.* The circumcorneal injection, the dilatation of the pupil, the turbidity which existed in the vitreous without any visible hæmorrhage, the manifest hyperæmia and transudation in the retina argued undoubtedly in favor of this diagnosis. The dilatation of the pupil and paralysis of accommodation are not infrequent in irido-choroidal affections, especially when the latter tend to serous effusions into the vitreous, as in this instance seemed to be the case. My views with regard to the diagnosis were not *incorrect*, but further observation of the case proved them to be *incomplete.*

The patient was submitted to a strong anti-phlogistic treatment. Six leeches were applied to his temple, and the after-bleeding kept up for two hours, an aperient was administered, the patient confined to his bed in a dark room, and spare diet ordered. His eye at once improved. The circumcorneal redness diminished, the pupil gradually contracted and responded to light, the sight became clearer, the turbidity in the vitreous and retina and the hyperæmia of the latter also disappeared gradually. But while these changes were going on, the ophthalmoscope revealed the existence of a *curved streak*, tab. I., fig. 3, situate between the opt. d. and macula lutea, running from below upward, turning its concavity toward the o. d., and measuring ¼ D* in breadth and 2 D in length. Its edges formed irregular, but sharp lines, its color was yellow at first, but became lighter afterward and finally white. The retinal vessels passed over it unbroken. No hæmorrhage was ever visible.

But there was another remarkable change taking place during the course of this affection. Below and inside of the od., and very near its margin, the choroidal tissue became rarefied (fig. 3, after the

* D is to signify a unit in ophthalmoscopic measurement, = one diameter of the optic disc.

inverted image). Irregular whitish spots and streaks were seen in it, lying so close together and even being connected with one another in such a way as to form a semi-circular zone around the opt. d., having 1 D in breadth, and reaching from the lower end of the before-described narrow choroidal streak almost to its upper end. A small part of choroid only, just above the papilla, was unchanged. This zone of whitish spots in the choroid was dotted with black pigment, collected in irregular groups, and lying partly within the white spots and partly at their edges. The whole alteration reproduced the picture we so frequently see in atrophic choroidal processes consequent on hyperæmia and exudation, especially in the higher grades of sclero-choroiditis posterior.

Two months later, when I examined the patient for the last time, the interior of the eye had entirely cleared up, the retinal hyperæmia and transudation had disappeared, the iris and pupil were in a normal condition, the power of accommodation was restored, and the acuteness of vision had risen to two-thirds of the normal standard. The boy was able to read small print without difficulty, and there were no spots before the eye when reading, nor any obliquity of the lines or distortion of the letters perceptible. Six months later I was informed that the eye had continued in the same good state.

This absence of metamorphopsia and of scotomata, together with the restoration of sight, proved that the whole affection had run its course without having caused permanent damage to the retina. That the immediate lesion from the injury was *rupture of the choroid* I need only mention, since the crescent-shaped white streak at the temporal side of the od. is the most common feature which this disease presents. The inflammatory symptoms in the vitreous, retina, iris, and choroid itself, were secondary to the rupture of the latter. The white atrophic and the black spots at the

nasal side of the od. were undoubtedly the effect of inflammation, for they bore the very same appearance as those changes we are wont to see after choroiditis. Nevertheless, I think it probable that the choroidal tissue in this region had been seriously bruised, and even lacerated to a small extent. Perhaps some of its layers only were torn, so that the sharp edges of a complete rupture were not visible, but only the image of the white spots form an atrophy which invades the different choroidal layers successively without always destroying them all. The turbidity of the vitreous may have been caused partly by inflammatory effusion, partly by extravasation of blood into the vitreous. Although I did not see any ecchymoses in the eye, it is to be noted that they have been observed in combination with isolated rupture of the choroid in almost every degree of intensity, but generally they are inconsiderable, so that they may be overlooked or cease to be recognizable when the examination is not made soon after the injury, or, as in our case, when a perfectly clear view of the background of the eye is not obtainable.

The dilatation of the pupil and paralysis of the accommodation may have been produced by direct bruising of the ciliary nerves from the blow, or by pressure on them from the choroidal hyperæmia and exudation. Among the many interesting peculiarities of this case, the most remarkable was its *terminating in complete recovery.* Whether the active treatment was conducive to that happy result, I am not prepared to answer positively, but I feel inclined to believe it, since this is the only instance I have ob-

served of complete restitution of the retinal functions in this lesion of the choroid. In all the other cases which I have seen, the patients had neglected treatment, and asked for advice later, when I had to deal more or less with an in curable condition. In the tabular statement of the cases of isolated choroidal rupture which are on record, there are but two of complete restitution of sight. In this case I could clearly observe the grave inflammatory consequences of the blow brought about in the iris, ciliary muscle, vitreous, retina, and choroid. Wherever such inflammatory changes, from whatever cause, have occurred, we deem it our duty to institute a serious treatment, of the usefulness of which every unprejudiced ophthalmic surgeon is satisfied. Why should it be inefficient or superfluous in cases where traumatic irido-choroiditis is complicated with rupture of the choroid?

Since Prof. *V. Graefe* described, in 1854, the first two cases of choroidal rupture diagnosticated with the ophthalmoscope, every ophthalmologist must have met with a number of similar cases, if he has directed his attention to the peculiar image this lesion shows through the ophthalmoscope. This image in its typical form represents a curved white streak, more or less concentric with the circumference of the od., having ½ D in breadth, and 2 D to 3 D in length, lying between the opt. d. and mac. l. From this typical form there are a number of variations, the most common of which are the following: the streak is sharply curved like the elbow, one branch lying on the outer, and the other on the lower, or less frequently, on the upper side of the od.; rarely the

line of rupture runs in a horizontal direction. Not infrequently two, and even more fissures are seen, running more or less parallel with one another; sometimes they are connected by transverse or oblique fissures, and not very seldom they bifurcate at one or both of their extremities. The retina, with rare exceptions, is uninjured. The *amount of hæmorrhage* produced by these isolated choroidal ruptures seems to vary greatly. Sometimes no extravasation has been observed, even in recent cases, such as the one just described; generally it is inconsiderable, and confined to the near neighborhood of the rent, in rare instances blood enters the vitreous, and even the aqueous chamber. The trifling amount of extravasation in most cases, after rupture of the vascular tunic of the eye, is an astonishing fact, which, nevertheless, is not without analogy.

Follin, in his "Leçons sur l'Ophthalmoscope," relates that he transfixed the sclerotic, choroid, retina, and vitreous with a couching-needle, then lacerated the retina and choroid opposite to the point of puncture, and had been equally astonished to observe no ecchymosis, or only a slight one, as long as by the manipulation no fluid escaped from the interior of the eye. He thinks that the equilibrium of external and internal pressure upon the walls of the vessels prevents the flow of blood, which explanation is indeed strengthened by the observation that the hæmorrhage became considerable whenever, by escape of vitreous fluid, the tension of the eyeball, and, correspondingly with it, the extravascular pressure had decreased.

The *secondary changes* of the injured parts also display

a great variety. Sometimes there is very little irritation, sometimes a certain degree of inflammation of the internal tunics which may pass away without damaging the retina, or the dioptric apparatus as we have seen so strikingly illustrated in our former case; but these happy issues are rarer than the unfavorable ones. The visual power remains more or less weakened, and sometimes is totally destroyed. Not infrequently, the impairment of sight existing shortly after the hurt, improves for a period of some weeks or months, and afterward becomes worse than it has ever been before. These variations in its course can be satisfactorily accounted for. The weakness of sight immediately following the injury, is due to inflammatory infiltration of the retina, especially its outer layers, and to exudation into the interior structures of the eye in general, perhaps also to bruising of the retina. All these conditions may pass away without definite impairment of the retinal functions. But they may, on the other hand, cause lasting changes in the delicate elements destined for the perception and transmission of visual impressions either by a thickening and degenerative process, or by atrophy. Both have been observed in that part of the retina which lies over and near the choroidal fissure, and in consequence thereof it loses its functional power more or less. The remarkable fact mentioned above, that after a period of improvement the sight gets worse again, and remains bad, is due to the *contraction of the cicatrized tissue formed in the choroidal gap.* The retina may become fastened to it, drawn backward and united to the sclerotic. Then the former regular distri-

bution of the retinal elements resembling a mosaic work becomes disturbed; and these elements, arranged previously in the regular retinal meridians, are displaced so as to produce secondary curves in the latter. When they thereby do not lose their functional powers, objects appear crooked and distorted—*metamorphopsia;* but when the sensory elements connected with the scar are destroyed, a corresponding *defect in the visual field* is observed—*scotoma.* Another consequence of this contraction of the cicatrized tissue has been pointed out by *Saemisch*, i. e. *detachment of the retina.* The retina then becomes firmly attached to the choroidal scars which, when contracting, may stretch the retina so much as to separate it from its union with the choroid.

The occurrence of a defect in the visual field by detachment of the retina, or destruction of the sensory elements lying over the choroidal fissures is easily understood; but the preservation of perfect sight, and the non-occurrence of metamorphopsia, or deficiencies in the visual field when the ophthalmoscope discovers extensive choroidal rents, is a surprising fact. The pathology of the choroid, however, furnishes analogous conditions not infrequently. We see, after exudative choroiditis, even if the retina has been involved in the inflammation, that extensive white patches—choroidal atrophies—remain on the background of the eye, and nevertheless S and F may be perfect. Further, in examining the size of Mariotte's blind spot in the visual field of eyes affected with posterior staphyloma, we often find the extent of the dark spot in the field of vision less than it

would be if the retina lying over the white figure surrounding the opt. d. were insensible to light. From these observations we may infer that the sensory elements of the retina may retain their faculty of perception, even though their usual base, the inner choroidal layer, may have been destroyed. This assertion is further confirmed by the numerous observations that detached portions of the retina became sensitive again, when the retina recovers its normal position.

After having pointed out some of the most interesting features which this remarkable lesion presents, I wished to be able to offer some plausible *theory on the mechanism of isolated choroidal ruptures;* but I confess to be not less puzzled on this point than other observers seem to have been. Only Professor *Saemisch* tries to give an explanation. He says that at the posterior pole of the eye the choroid is, by its vessels which perforate the sclerotic, in close coherence with the latter. Any shock effecting some displacement of the inner tunics from one another, would allow a motion of the whole retina upon the choroid, except at the ora serrata, where it is intimately connected with the choroid. This latter membrane adheres, at the posterior pole and in the region of the ora serrata, where the anterior ciliary vessels perforate, more intimately to the sclerotic. A shock tending to displace the choroid from the sclerotic would, therefore, cause laceration of the former in these two regions. To strengthen this assumption *Saemisch* asserts that all the isolated choroidal ruptures were at the back of the eye, and in the one case, where both choroid

and retina had been lacerated, the lesion was near the ora serrata.

Although this sounds like a reasonable explanation, it never has satisfied me. The region of the ora serrata is not exactly at the entrance of the anterior ciliary arteries, but lies back of it. At the posterior pole of the eye, I can well imagine a shock may effect displacement or distension of the choroid, and not be sufficiently powerful to rupture the trunk of a perforating ciliary artery. The latter then acts as a fixed point, stopping the movements of the tissue on one side, while that on the other side is torn violently from it, and thus lacerated.

This partial attachment of the choroid to the sclerotic, by means of the ciliary arteries may, perhaps, *favor* in some degree the choroidal rupture, but I think the explanation will be more simple and faithful to nature, if we try to adapt it to the various facts known under the designation of "*fractures par contrecoup.*" The skull has furnished, thus far, the greatest number of observations belonging to this class. The shock or blow received, for instance, at the right side of the skull produces in one series of instances a separation of tissue at the point of injury, such are "direct or immediate fractures;" in another series the blow is conveyed or transmitted to a distant part with so much force as to overcome the resistance and elasticity of the tissue, that is, to cause the separation of its structural elements. These are "fractures or ruptures par contrecoup." The resistance and elasticity of different adjacent tunics or walls being different, we may fairly admit that those structures are

first and more extensively torn which possess the least degree of both. The analysis of the effects observed, in certain cases of such injuries, may offer the greatest difficulties, since an indefinite number of insufficiently known causes may have been at work in the production of so complicated a result. Besides the *power and direction of the forces, we have to take into account the physical qualities of the different parts acted upon.* So we find that injuries on the head, in some cases, fracture the bones at the opposite side of the skull, while in others they leave them uninjured, but cause extensive hæmorrhage of the pia mater and the brain substance, the result of laceration of those soft parts which lie opposite to the place directly hit by the blow. Such a case I saw in one of the last meetings of the New York Pathological Society. Dr. *Finnell* showed the brain of a patient who had fallen from a stoop and struck his head against the stone pavement. When taken up he was insensible, and shortly after died. At the autopsy a considerable amount of extravasation under the scalp was noticed over the right parietal bone, the seat of the fracture, and on the removal of the calvarium a large clot of blood was found, covering nearly the *whole external surface of the hemisphere of the opposite side.* (See *Medical Record*, vol. iii., p. 521.) It can not be said that the pia mater and brain substance were, physiologically, more closely adherent to the d ra mater and bony wall of the head, just in that region where the hæmorrhage was situated, nor was there any pathological adhesion observed. In the same way we see, in some cases, the choroid ruptured without laceration of the sclerotic or

retina. From this fact we may deduce no other conclusion than that the choroid proves less resistant or elastic than the two other tunics of the globe. But the choroid is by no means the only membrane of the eye that shows isolated ruptures. The zonula Zinnii and the lens capsule, and sometimes even the iris, are easily lacerated, and in various ways. Dislocation of the crystalline is not an infrequent occurrence after blows upon the eye. The anterior capsule has often been found to be lacerated, and, in one most curious case, I even observed, after a blow, an isolated and *circumscribed rupture of the posterior capsule* at the posterior pole. This case was observed in its course at my clinic; the lens substance remained for a time transparent, while the posterior cortical layers became successively opaque, and protruded through the fissure into the vitreous body in just the same manner as it penetrates into the anterior chamber after discision of the anterior capsule. Dr. *Lawson* (Injuries of the Eye, Orbit, and Eyelids, London, 1867, p. 246) relates a remarkable observation of isolated *Rupture of the Retina at the posterior pole of the eye.* A sailor had struck his eye against one of the stanchions of a ship. When Dr. *L.* saw him, ten months later, the eye had recovered from the injury, but its sight was very much impaired. In the immediate axis of vision he was blind, when looking laterally at either side he could read No. 16 of Jaeger. In the immediate neighborhood of the yellow spot there was a small rent seen in the retina, the edges of which could be distinctly made out. Behind it lay a black deposit, either the remains of a blood clot or a collection of pigment.

It is not improbable that the choroid was ruptured at the same time, and the rent hidden from view by the black deposit.

Ruptures of the sclerotic itself are very seldom recorded. As far as my experience goes, the upper anterior part near the corneal margin is the most frequent seat of this occurrence, which agrees with Mr. *Lawson's* statement. He says (*l. c.*, p. 263), "the split in the sclerotic is almost invariably near the margin of the cornea, following somewhat the direction of its curvature. The upper side is the most frequent seat of it, next comes the inner, and comparatively seldom the lower and outer side." More than one case is fully described in my journals, where the sclerotic had been lacerated, just as if a superior flap-extraction had been performed within the sclerotic, the lens having escaped through the gap, and the iris prolapsing into it. In other instances the sclerotic has been seen lacerated further backward, the crystalline thrown out through the opening, and lodged between the sclerotic and the uninjured conjunctiva in the subconjunctival tissue.

All these various cases of injuries of the eyeball have mostly been recorded, up to the present day, as ophthalmologic curiosa, and will remain so until the observations are sufficiently numerous and explicit to afford a general description, giving us full insight into the relations of cause and effect, that is, the explanation of their mechanism. The isolated choroidal ruptures form only one section of this series. Although they are not very infrequent, and are easily recognized, it is rather surprising that, since the

description of the first two cases in 1854, only fifteen others have been published, and only a single one, that of *Von Ammon* has been elucidated by a post-mortem examination. The different treatises on eye diseases make but slight mention of them. *Mauthner* gives the fullest account of them, and devotes five pages of his most valuable Treatise on Ophthalmoscopy to their description. The great practical importance of this lesion, the different interesting questions it raises with regard to its mechanism, and the analogy it bears to similar traumatic affections of the head, will certainly justify and reward a more extensive study of it.

The following case is of *special interest on account of the changes which subsequently took place in the region of the yellow spot.*

Ph. T. Westenhöfer's son, from Klingenmünster, Palatinate, had been hurt, four weeks before I saw him first, by a clod that flew on his right eye. The eye at once became painful, lids and conjunctiva swollen, and all objects appeared very dim. After two days the swelling and pain subsided, the general dimness of the visual field contracted into one dark spot lying just before the object looked at. In this condition it had remained until the patient came to me for advice. The external appearance of the eye indicated nothing abnormal except a dilated and immovable pupil. No remedy had been used. With +8 the patient could read Sn. XIV., but a dark gray round spot lay directly over the letters looked at. At the distance of a foot this spot assumed a diameter of about 15 mm. Through it the letters could be made out; none were wanting, imperfect, or distorted, and the lines, when held in a horizontal, vertical, or any other position, were in no way crooked. Tn. E.—Left eye normal.—With the ophthalmoscope I saw two curved white streaks (Tab. I., Fig. 4) between the

yellow spot and the optic papilla, turning their concavity towards the papilla, the larger outer one having 5 D in length and $\frac{1}{3}$ D in breadth, the smaller $1\frac{1}{2}$ D in length and $\frac{1}{6}$ D in breadth.

These streaks had the usual appearance of choroidal ruptures: they were white, had sharp, somewhat torn edges, black pigment scattered on their area and along their edges, the retinal vessels branching over them in the usual way. The *region of the yellow spot exhibited a finely circumscribed extravasation;* the blood a little darker at the periphery. This was the evident cause of the scotoma in the centre of the visual field. As all symptoms of irritation had passed off, I only gave the patient mercurial ointment to be rubbed into his forehead and temple. A fortnight later, when he came to me again, I found no material change in his eye. A month after that the external appearance of the eye and dilatation of the pupil were as before, the white streaks in the choroid unchanged, but the red patch at the yellow spot had become somewhat blanched, and a number of dark-black dots were irregularly scattered over its area. The patch itself had a little enlarged, the adjoining tissues were still normal. *With spectacles* + 8 *he now reads Sn.* $1\frac{1}{2}$ *fluently at* 8 *inches distance.* No power of accommodation. The scotoma still existing, but smaller and much paler. No metamorphopsia. Experiments similar to that of *Mariotte* revealed no abnormal blind spot in the excentric field of vision. Indirect sight was perfect. Five weeks later the patient presented himself again, this time with interesting changes in his eye. The scotoma in the centre of the visual field had become enlarged and much darker, so that now No. 11 Sn. only could be read by indirect vision. The dark spot in the visual field had a peculiar shape, such as represented in Fig. 4, A., which was drawn by the patient himself as seen at the distance of one foot. Straight vertical lines were interrupted, that is, not recognized in the central scotoma. *The lower ends of their upper parts were markedly bent towards the middle line*, the latter showing no

curvature. The lower parts of the vertical lines appeared straight in their whole course. When the patient looked at the centre of a piece of money, a Prussian two-thaler piece, for instance, *the upper border appeared more strongly curved, as if belonging to a smaller circle* (Fig. 4, B). Of this he could see the upper third only, whilst the two lower thirds were hidden by the scotoma. In looking, not at the centre of the piece of money, but on a point situated midway between the centre and the upper border, the two upper thirds of the coin were hidden, and the lower likewise appeared somewhat smaller than when he looked at it with the healthy eye. *This metamorphopsia and micropsia*, as I shall presently explain, had a common cause.

I examined the eye with the ophthalmoscope and found every thing in its former state, except the région of the yellow spot. The red stain—due to extravasation—was still well marked in its outline, which was studded with dots and short lines of black pigment (Fig. 4, C, erect image). The outer half of its surface was red as before, only somewhat motley, red patches intermingled with yellowish ones and black dots. The inner half was whitish, traversed by red and white streaks, and besprinkled with black dots. The retina, adjacent to this stain, was opaque, forming a bluish zone around it in a breadth of about $\frac{1}{3}$ D. This zone, as well as the white streaks on the inner half of the extravasation, were slightly raised above the level of the retina. A month later the patient came again to me, but functional and ophthalmoscopic examination revealed no change in his eye, except that the extravasated spot was less red and it showed a greater amount of black pigment.

REMARKS ON THE FOREGOING CASE.

The isolated ruptures of the choroid between yellow spot and opt. n. are usually caused by concussions. The extravasation on the mac. l., however, is unusual. It must have

been occasioned by the accident itself, and not by a subsequent choroido-retinal inflammation, because the patient noticed the corresponding scotoma immediately after the injury. As the hæmorrhage presupposes a rupture of vessels, and as the choroid is most essentially a vascular membrane, we may admit, that at the mac. lut. another smaller rupture of the choroid was caused by the injury. The most remarkable feature of the case is its course. Gradual improvement during the first two months, so that the visual power had nearly returned to its original standard. After that, however, vision became gradually worse again, and a most distinct and dark scotoma, that is a circumscribed blind spot or defect, developed itself in the centre of the visual field, where it had existed, in a less degree of intensity, during the first weeks after the injury. The surroundings of this blind central spot in the field of vision showed characteristic distortions of objects, of which I have noted and illustrated the two most striking ones. The experiment with the vertical lines (Fig. 4, *A*) is thus to be explained. The choroidal rent at the mac. lut. produced at first a certain degree of inflammatory action, by which a new formation of connective tissue took place in the neighborhood of the gap. By this tissue the retina and choroid were firmly glued together. Wherever a new formation of connective tissue to any considerable degree is brought about, contraction most commonly follows. This latter causes dislocation of the neighboring tissues by drawing them in that direction where the greatest amount of cicatrix has been produced. In this case the contraction of the cicatrix must have been

in a horizontal direction, and especially manifest at the lower border of the rent. The effect of this contraction might be expected to bring both sides to the centre. This, however, did not happen, but just the contrary: the retina overlying the choroidal gap was drawn in lateral directions both to the right and left side. The contraction, moreover, was pretty equal in its effect on both sides. The retina by this stretching was detached from its concave basis, being stretched over it as a chord over its arc. These anatomical conditions may, with unerring certainty, be seen by the one simple experiment with straight lines. The detachment is proven by the existence of a blind spot in the visual field, the bluish-white color, and slight elevation of that part of the spot which had been cleared from blood. That this detachment of the retina was the result of a stretching, in such a manner that a plain surface was extended over a concave one, is not only a simple result of the anatomical conditions, as *Saemisch* has set forth in the analysis of a similar case, but our observation demonstrates the correctness of this supposition by the visual proofs. The ends of the straight lines appeared bent towards the middle line. This signifies that the retinal elements lying in the retinal line *c b*, Tab. I., Fig. 4, A, were formerly so situated that they received the image of the curved line *c a* in the visual field. If we make a copy of this figure 4, A, and turn it upside down, then the latter may represent the retinal image of the former. The retinal elements, lying in the line *c b*, of a healthy eye, would, on being made the recipient of an image of a corresponding straight line without the eye, cause the sensation of this straight

line in the visual field. But suppose now the retina being so stretched at this spot, that the elements of the curved line *c a* had taken the position of *c b*, and the same straight line outside the eye having unvariably kept its former place, then its image would fall upon the retinal elements which were formerly situated in the curved line *c a*, and would, according to the law of visual directions (see pp. 190 and 191 of these archives), be so perceived as to create the notion of a curved line in the visual field. This law, that a dislocation of the sensitive elements of the retina and other nerves causes a false localization of the objects of perception, is a well-known fact. The dislocated retinal element will project impressions of light always in the same direction as it used to do before its dislocation. If a rhinoplasty has been made by transplantation of skin from the forehead, pricking the new nose will give the individual the false impression as if his forehead had been pricked.

The irregular appearance of round objects, for instance a piece of money which our patient had noticed, and illustrated in Fig. 4, B, Tab. II., is accounted for in the same way. The retinal image of the object was portrayed now on elements that formerly lay closer together. After their distension, they occasion the notion of a smaller object in the visual field, exactly of such size as would have been brought about by a retinal image covering them in their former normal position. That the traction of the retina has been equal in both lateral directions ensues from the fact that the middle vertical line, Fig. 4, A, did not appear displaced or crooked.

This analysis of our case offers a fair example of what kind of changes may take place, when a longer period of time has elapsed after the injury. It confirms the ideas of *Saemisch* with regard to the mechanical manner in which detachment of the retina may be produced. But this kind of change is by no means the only one. The cones and rods of the retina may be injured and destroyed in many ways. The injury may bruise or tear them together with the choroid; the hæmorrhage and subsequent inflammatory action may blunt or annihilate their functions; the formation of a cicatrix in the choroidal rent may distort, compress, and unite them to the sclerotic. In the latter instance another kind of metamorphopsia would be the consequence; straight lines would be bent outward, and objects appear larger, because of the retinal elements lying then closer together than natural. The fact observed by *Saemisch* during the course of the foregoing case, viz., that soon after the hurt a considerable improvement of sight may take place, which afterwards will be lost again, is by no means the exception; but rather the rule. In all the recent cases that came under my notice I observed it, except in the one first related here. The ultimate deterioration of sight must be ascribed to the prejudicial influence of the choroidal scar on the membrane of the rods and cones in one or the other of the ways just described.

The first case of isolated choroidal rupture I have observed is that represented in Fig. 5, Tab. II.

A healthy man, Joh. Riehm II., from Käferthal, near Mannheim, was hurt, twelve days before his presentation in October, 1861, by

a piece of wood flying against his right eye. He was unconscious for some time, had dimness of sight and swollen lids. When he came to me there was ecchymosis of the lids, but no inflammation, conjunctiva and globe uninjured, iris normal, pupil responsive. He had a very dark scotoma in the centre of his visual field, but normal vision in all peripheral parts. With the ophthalmoscope I discovered a round red speck exactly in the region of the yellow spot, reaching very near to the opt. d., and measuring about 3 D in diameter. The centre of the red spot was darker than its periphery. Just beyond the centre, about 2 D distant from the opt. d., was a white vertical streak, ending in a point above, and in three notches below (the figure represents the inverted image). The length of the streak was 2 D, and its mean breadth $\frac{2}{3}$ D. Its surface was whitish-yellow, with some red lines, its edges were sharp, somewhat elevated, and in some places red from accumulation of blood. The retina was uninjured, and free from hæmorrhage. The blood was gradually absorbed, but the patient retained a central scotoma, although less extended and less intense than at his first calling on me.

This may be regarded as one of the usual forms in which isolated choroidal rupture is observed.

The following case, represented in Fig. 6, Tab. II., has some peculiarities. It came under my notice in December, 1861, a twelvemonth after the injury. This had been caused by a shot from a pistol loaded only with powder. The grains of the latter were still visible on the face and on both eyes, more abundantly on the left, where they located in the cornea and sclerotic. This left eye has suffered constantly since the injury. Repeated attacks of pain and redness set in from trifling causes. The patient was able to count fingers with this eye at 1′ distance only. A black veil was constantly masking the visual field, which itself was very much contracted.

Small black bodies and clouds were constantly floating before the eye. Tn. With the ophthalmoscope floating opacities of the vitreous were observed obscuring, to some degree, the fundus. A curved *horn*-like white streak surrounded the lower and outer side of the opt. d. (See Fig. 6, inverted image.) In the lower and outer part of the fundus of the eye remarkable changes were detected. A great many irregular white spots were manifest defects of choroidal tissue, exposing the sclerotic to view. The larger choroidal vessels were preserved, and the retinal vessels were seen to pass through this region without any marked alterations. Black pigment was deposited irregularly in and around these white spots, as is usually seen in atrophic choroiditis. In one place, however (the highest and innermost in Fig. 6), the retina was detached to a small extent, like an oval sac of bluish appearance.

The injury in this case had a double effect. It caused rupture of the choroid par contrecoup near the opt. d. in the usual form, and, beside that, choroiditis or choroido-cyclitis at the place where the powder had infringed on the sclerotic. The latter effect I have not infrequently seen, especially in the form of a very unpleasant cyclitis, producing plastic exudations, stretching from the ciliary body towards the posterior pole of the crystalline. Perhaps it would have been advisable to remove that eye, but since I did not hear of the patient again, although I was in his neighborhood for eight years, I do not think it likely that sympathetic trouble ensued.

The case represented in Fig. 7, Tab. II., is remarkable for *the extent and shape of the choroidal rupture, including three-fourths of the opt. d.* The rent had been produced by a blow without lesion of any other part of the eye. A

certain degree of choroiditis must have followed it, for there were some marked atrophied spots in the choroid.

The two following cases were remarkable for showing distinctly the formation of cicatrized tissue in the wound and its adjoining parts :—

The first, Fig. 8, was that of a woman, 33 years of age, who had received, five years before, a blow on her eye. She did not feel much inconvenience from it, but her sight had become impaired. When she came to me she could count fingers six to seven feet distant. Excentric vision good. Nothing abnormal in the external appearance of the eye. With the ophthalmoscope I discovered at the background of the eye a distinct white streak, crossing the region of the yellow spot vertically and dividing into four off-shoots, two above and two below. The edges of the streak and part of its area were covered with black pigment. The white specks between the pigment had a slightly fibrillous appearance, and were distinctly raised over the level of the surrounding retina. They were not only detached retina, but rather thickened cicatrized tissue involving the retina. The retinal vessels passed over both terminal portions of the rupture.

The next case is that of a woman who had received, twenty years ago, a blow from a stone being thrust on her eye. She knew little of the subsequent history of the disease, having always been accustomed to consider this eye as incurably blind. On examination I found only slight perception of light. Nothing abnormal in external appearance. Iris and lens normal. Media clear. At the background of the eye a large crescent-shaped white spot encircling nearly the whole opt. d. (Tab. II., Fig. 9, erect image.) The latter abnormally white. Its vessels few in number, but only a little narrowed in calibre. The white spot had sharp edges lined with black pigment, through which loops of the choroidal vessels

were visible. The latter were very marked, especially in the superior small extremity of the patch, through which they passed from side to side, and could be traced into the choroidal tissue for some distance, the pigment layer being very light. The area of the white patch was slightly mottled with grey specks, but what was most remarkable was a number of brilliant white, fibrillous bands, stretching across the area of the crescent, enveloping very distinctly some of the retinal vessels, and projecting unmistakably over the surrounding parts. Along the inner and lower margin of the crescent these fibres crossed one another in different directions, radiating for the most part towards the periphery. Just below the opt. d. the white fibres stretched and radiated like a bundle of rays of light.

This is the most extensive of all the choroidal ruptures I have ever seen. It must have caused a considerable degree of inflammation, as we may judge from the great amount of new-formed connective tissue in the area of the gap. It does not seem probable that the retina was ruptured at the same time, for its vessels still crossed the rent uninterruptedly. It is remarkable enough that they were not compressed by the bands enveloping them. The vessels themselves were distinctly seen passing through the white bands; they could not only be distinguished beneath the superficial layers of the latter, but emerged also, in some places, from them for a short distance, and again passed below them, as is represented in the superior branch of Fig. 9. By the inflammatory products the retinal elements must have intensely suffered, as the nearly total blindness of the eye demonstrates.

ON THE THEORY OF BINOCULAR VISION.

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(See Tab. V., VI., VII., Figures 1 to 16, & A. B.)

In a recent essay on the *Horopter*, in which especially those lateral positions of the eyes were examined in which the fixation does not lie in the primary position of the plane of vision, I received an unexpected, and, as it seems to me, a highly important explanation of the manner in which we see with both eyes at once. The view to which I was forced on this subject, was not arrived at without much hesitation and distrust of the impressions of my own senses, as I had always felt the greatest respect for the theory of *Hering* and *Helmholtz*, and indeed regarded it as axiomatic. I shall begin with an analysis of this theory.

I.—The Theory of Hering and Helmholtz.

Helmholtz says on the 611th page of his "Physiological Optics: We must imagine exactly between the two eyes a middle or "cyclopean eye," which is directed to the

fixation point common to both eyes, and whose movements follow the same laws as those of the real eyes. Suppose the images on the retina transported from one of the real eyes into the imaginary one in such a manner that the point of vision falls upon the point of vision, and the horizon of the retina upon the horizon of the retina. *Then the points of the retinal images will be projected outwardly in the direction of the imaginary cyclopean eye.* If we suppose, for instance, our right eye to be immovable, but allow the left to pass from the parallel to a convergent position, *i. e.*, to move towards the right, by which it will in general make a rotation around the optical axis,* then the cyclopean eye would be compelled to turn in an angle half the size towards the right, and to perform half as large a wheeling rotation. The consequence of this is, that the visual images of the right stationary eye are apparently moved and turned in the same angle. As the meaning of these sentences, especially in regard to physiological single and double vision, will not be immediately understood by every one in its full import, I shall premise a few words concerning the *horopter* and the identity of the retina, and then give a more particular explanation.

* Among the different movements of the eyeball, by which the visual line, or optical axis, is directed to any point in the field of vision, a rotation of the eye around its optical axis may at the same time take place. The German physiologists express this kind of rotation by the word *Raddrehung*—turning of a wheel—because the retina is thereby turned like a wheel around the optical axis. The word being highly expressive and needed, we have ventured to make a literal translation of it into *wheel-turning or wheel-rotation.*

The existence of double images proves that we do not see every point of the outside world, at least not with each eye, at the place where it really is. If we fix our eyes upon a point before us which shines with its own or borrowed light, then we shall see in general the other parts of our field of vision double, those of them only excepted which form an image upon the identical places of both retinæ.

In Fig. 1, m_1 and m_2 are "*corresponding*" points, because their co-ordinates are the same; that is, $p_1\, m_1 = p_2\, m_2$ and $q_1\, m_1 = q_2\, m_2$.* They become "*identical*," if there is or can be represented upon them, in any given position of the eyes, *i. e.*, in quiet fixation of any point in the field of vision, any illuminated or luminous point in space. If both eyes look straight forward towards a point of the horizon in infinite distance (" primary position of the plane of vision "), then the plane of the horizon will cut the retina in two circles, which are called the "*horizons of the retina*." The lines $a_1\, b_1$, $a_2\, b_2$, represent arcs of these circles. If the point of fixation of both eyes lies at a limited distance, and not in the continuation of that plane which divides the body into right and left halves (median plane), but laterally to it, the eyes will make a rotation around their axes, which nearly correspond with the lines of vision, and consequently the retinal horizons $a_1\, b_1$ and $a_2\, b_2$ will form an angle. The contents of this angle are given by the formula of *Listing*.

The proposition that an objective point, which is por-

* We must here disregard, for the sake of clearness, the influence of the apparent vertical meridians.

trayed upon identical points in both retinæ, is seen singly, may be regarded as a truth sufficiently demonstrated by experiment.*

In any given position of the eyes, by which any point at a limited distance is fixed, there is always only a continued row of points in the field of vision, which are seen singly, and form together one line.† This line in space, which always passes through the fixed point, and all whose parts are seen singly, is called "*horopter*." According to the theory of *Hering* and *Helmholtz* we do not see with each eye by itself, during any quiet position of the eyes, the lines of direction running towards different objective points, but as though there was a single eye between the two real eyes, in the region of the root of the nose—the so-called *cyclopean eye.*

By this, however, it is not intended that our seeing with two eyes is in fact only seeing with one eye, otherwise double vision would be impossible; but this cyclopean eye is in fact to be regarded as a concentric double eye, both whose retinal concavities, superposed one upon the other, have identical points of impression only for those objective points which lie in the horopter.

In order to represent more distinctly the relations of the cyclopean eye, Fig. 2 may serve, in which F is the fixed point, c_1 c_2 are the centres of the right and left eye, and c is the centre of the cyclopean eye. The fixed point F is now seen

* Certain restrictions of this proposition do not detract from its general correctness.

† The ground horopter-plane of *Helmholtz*, which rests upon his theory of the apparent vertical meridian, is here disregarded.

by the latter in the direction of c F. The point m, which we allowed to lie outside of the plane of vision c_1 F c_2, will be portrayed on the retina of the right eye at m_1, on the retina of the left at m_2.*

If we draw the straight lines marked by the letters μ_1 c n_1 and μ_2 c n_2 relatively parallel with m_1 c_1 m and m_2 c_2 m, then the point m will, by the cyclopean eye, be seen double, namely at n_1 and n_2. By this we are enabled to get an insight into the theory of *Helmholtz* quoted above.

Hering calls the directions in which the cyclopean eye sees the objective points, singly or doubly, "*directions of vision.*"

He allows, in general, of no other vision than that by means of the imaginary cyclopean eye from the time that man has learned to distinguished the visible world from his own self. He says, in his "Contributions to Physiology," p. 166, par. 70, "If in symmetrically placed eyes the retinal fossa of one eye is irritated, then the corresponding image appears in such relations to our own body, of which we are, at the same time, conscious that the plane of a section which divides the imaginary image of our body into symmetrical halves, in its prolongation passes through the visual image of the object. Whoever calls the visual image of his body his own self, may then say he sees the objects immediately before him. But the real object which produced the retinal image need not, therefore, lie in the same relative

* We must remember that the straight lines c_1 E and c_2 F, are called lines of vision, and that the plane c_1 F c_2 is called the plane of vision.

position to our real body. If we fix both eyes upon a finger held straight before the face, it will appear in the median plane above mentioned; if then we shut the left eye, the finger remains, as before, in the median plane.

Immediately behind the finger, in the same median plane, there will appear, perhaps, a window frame, or a tree, or some other object. The corresponding real window frame, or tree, does not lie at all in the median plane of our real body, but more or less to the left side. Without regard to the real place of an object, and to the relative position which then the line of vision assumes with reference to the median plane of the real body, the visual image appears in the median plane of the imaginary body as soon as the retinal image is formed on the fovea centralis of one or both of our eyes, being in a symmetrical position.

If the image is formed laterally upon the retina, it appears to the side of the median plane of the imaginary body; if it lies above, it appears beneath, &c. By this relation of all visual images to the simultaneous imaginary image of our body in our mind, the latter image becomes the starting point of all the directions which may be conceived between it and the surrounding visual images. These directions which our imaginative faculty assumes in space, are the *directions of vision or visual directions.* For simple reasons which we can not stop to explain, it is permissible to accept for the visual directions a single point of intersection just as for the visual lines. As, however, to our organ of vision pertains not only the perception of direction, but also that of the distance of objects,

and the latter materially results from binocular vision, therefore Hering ascribes to the cyclopean eye the faculty to discriminate, quasi to feel, the distance of the visual objects, and this it does according to the retinal meridian in which the direction of vision lies.

This *sensation of space or depth* of the retina is, according to him, not the same for the images which lie in corresponding retinal meridians, but only for the images of those retinal meridians which form, with the median plane, equal angles only, preceded by inverse signs. He calls these *symmetrical meridians.* Now, if the angles of these meridians, on one side positive and on the other negative, are not equal, then the sensation of depth will correspond to the arithmetical medium of the absolute size of both angles (pp. 293-4, *l. c.*).

We believe that the ingenious author has arrived at this theory only by too general and exclusive an application of the cyclopean eye to the act of vision.

II.—The Prevailing Eye.

In venturing now to explain the view which has been more forced upon us than sought for, we will begin with some observations on *vision in taking aim* (Visiren).

In taking aim, we try to determine, as near as possible, the *direction* in which a luminous point is seen, without regard to its distance. Everybody will grant that in this process only one eye is used, even if we keep the other one open at the same time, and direct it on the object aimed at. In the first place, the other eye is not necessary, as we have

no regard to the distance of the point which is aimed at; and, besides, it is only possible to aim accurately in the visual line of one eye. Let us try the following experiment. Desire a perfectly unprejudiced person who sees clearly with both eyes, and who is right-handed, to hold his finger perpendicularly and raise it from beneath upward until it comes in front of any given point on which he gazes with both eyes, that is to hold the finger so that the object seems to be behind the middle line of it. He will always place his finger in the visual line of the right eye, so that, by closing the left, the point of fixation will be completely covered by the finger.

If, on the contrary, he is requested to bring the finger to the point of fixation by moving it from left to right, he will stop when the finger comes into the visual line of the left eye, and, consequently, he will have effected the adjustment for the left eye.

The same result will be obtained if the finger is held horizontally, from before backward, instead of vertically. If, on the contrary, we request that the left index finger, being held horizontally, be moved from below upward into the visual line of the left eye, this will, in most instances, not be arrived at, but the finger will be so moved that its end will lie in the visual line of the right eye. When I try this experiment myself, it does not generally succeed; if I accommodate for the finger, and if I want to be sure of the result, I must first call to mind the double images of the finger, and adjust the right image to the left eye.

Most people, therefore, in taking aim, do not voluntarily

use either one eye or the other, but allow the stronger, generally the right, to prevail over the other. I think we may assume that this peculiarity, as it has a certain analogy with the prevalent use of one hand, stands also in casual connection with it. From childhood up we are trained to use principally the right hand in all our actions; hence arises the prevailing use of the right hand. As we naturally use this hand by preference in all those actions which demand sharp sight, or prolonged aiming in childhood, in touching, striking, throwing, &c., in riper years in shooting, fencing, hewing, &c., we come also to use the corresponding eye in a prevailing manner; for we are unable to execute such accurate motions with the right hand if we look or aim with the left eye and close the right.* Nor can we do this with the cyclopean eye of Hering, that is, if we use both eyes in the same manner and at the same time. (Indistinctly conscious of this, most sharp-shooters believe that they can not shoot accurately with both eyes open.) By all this, according to my opinion, the prevailing use of one eye, generally the right, is satisfactorily explained.

The contrary proposition, that one who is left-handed also uses principally the left eye, is not to be admitted without circumspection. A man whom I know, though he is left-

* If, for instance, we place a finger of the right hand in the visual line of the right eye, and then shut that eye and attempt to move the finger rapidly towards the point of fixation, the finger instead of having approached the point of fixation directly, in following the visual line of the right eye, will have deviated considerably to the left. But if we keep the right eye open, we can move the finger forward as far as our arm can reach in the visual line of the right eye, though we likewise see the fixation point with the left eye alone.

handed for most purposes, is obliged in many actions which demand aiming in the visual act, for want of corresponding tools, to use the right hand and the right eye (he is a cooper, and is obliged to use an adze made for the right hand for hewing the staves, he is also a sharp-shooter, and has a rifle stocked for the right hand). With him the right eye is the prevailing one. For this investigation, those individuals are best adapted in whom the right hand is wanting or crippled from birth. One such case happened to come to my knowledge, and was quite in favor of my hypothesis. In this person, of whom I speak, who had a crippled right hand with only an atrophied thumb and forefinger, but no other defect, the left eye was the prevailing one to such a degree, that he thought he could do nothing with the right eye alone, although nothing abnormal was discovered in it, and he himself was not aware of any dimness or confusion of images.

Although I am of opinion that every man possesses a prevailing eye, I will by no means deny that with many, by exercise, for instance, in taking aim, in looking through the microscope and telescope, the other eye may become as available as the predominant one. The latter, however, retains nevertheless its once acquired superiority, as can easily be proved by an experiment referred to in the following section.

III.—The Mode of Binocular Vision.

To what has been said in the previous section, with regard to taking aim in seeing, must be added the following: If we place a straight wire *a b* in the line of vision of the right eye O_1 (Tab. V., Fig. 3), while the open left eye O_2 is likewise directed to the point of fixation, then must, according to the theory of the visual lines, the right eye, transferred to the imaginary cyclopean eye, see the wire *a b* in the direction of M F, but the left eye in $a_1 b_1$. Now, the first conclusion manifestly is not confirmed by the experiment,* but we see the wire *a b* with the right eye O_1 in its own visual line. (The position of the double image of *ab*, which is seen by the left eye, we shall leave unnoticed, as being here of no particular interest.) One might say this was an exceptional case, the points *a b* lying too near the right eye to allow both eyes to act uniformly. While we grant this for the present, we assert the following proposition: *If we bring a point* a *pretty near the eye* O *in its line of vision, while both eyes are directed to the point* F, *then the eye* O *sees the point* a *in the line of vision* O F *and not in the direction* M F.

Suppose a somewhat distant point, F (Fig. 4), which we fix, is straight before us in the median line M F, and another

* Even in the experiment of *Helmholtz* (Phys. Op., 612, 613), where a finger, being hidden behind a shade, is moved from below upward into the line of vision of one eye. it is asserted that it comes into view correctly if the situation of the right fixing eye is distinctly remembered. I come, when the right eye is looking, with my finger nearly always into its line of vision; on the contrary, if I look with the left eye, the finger usually appears far to the right.

point *a* (say a pin's head) be in the same line, also straight before us, tolerably near. If we look alternately with one eye only open, towards *a*, we shall see with the eye O_1 the point *a* in the direction $O_1 r$ so far from F towards the left as it is with the eye O_2 towards the right in the direction $O_2 S$.

If now we fix the point F, we shall see a double image of *a*. In order to determine the position of this double image, we bring a second point *b* before or behind *a*, in such a manner between the double images, that its double image which is seen by the right eye lies exactly in the middle between the double images of *a*. If now we shut the left eye, we see the point *b* exactly in the visual line of the right eye.

As now, according to the previous proposition, *b* really lies in this line of vision, and is besides found exactly between both double images of *a*, it follows, *that both double images lie symmetrically on both sides of the visual line of the right eye in* a, *and not so in regard to the median line* M F. If we continue to move *b* by unchanged fixation on F so far towards the left that its double image, which is seen by the left eye, falls exactly between both double images of *a*, and then close the right eye, we shall find that now *b* lies in the visual line of the left eye, about in the position of B, *so that we*, if we have held our first impression of the double images *a a* unchanged, *see the double image of* b *in the visual line of the right eye, although it lies in the visual line of the left* (*in* B), and is seen with the latter at the very same place *b*, where we before beheld the image seen with the right eye. The double image of *b* formed by the right eye

will be seen in its true position at B. If, on the contrary, we first bring the double image of *b*, formed by the left eye, exactly between the two double images of *a*, maintain the impression we receive of the position of these double images, and continue *b* so far towards the right that its double image seen by the right eye falls exactly between those double images, we shall easily convince ourselves *that we see the double image which belongs to the right eye* (*really lying in the visual line of the same*) *in the visual line of the left eye*, while the double image of the latter lies in its true position.

We conclude from this, that, in the act of seeing, we involuntarily or voluntarily permit one eye to prevail or dominate, and visible objects are seen with this eye in their true places, while they are seen with the other eye in such a way as if the latter were, together with the impressions its retina had received in its true position, transferred upon the prevailing or dominating eye, just as above, according to Helmholtz, both retinæ were transferred to the imaginary cyclopean eye.*

The relation here is obviously more simple, as only the one eye is supposed to be transferred upon the other, which remains unchanged in all respects. All points which do not lie in the horopter are accordingly also seen double. But

* The idea of prevalence is absolute, since according to my view, as has been said above, every man has an absolutely prevailing eye, although not in the same degree as is the case with the prevailing arm, because the muscles of the eyes can not be used on one side more than on the other; the idea of domination, on the contrary, is relative, as it lies in our power for a special purpose to subordinate one eye to the other.

the impressions of the weaker eye are suppressed in ordinary vision by the stronger one, and only those parts of the field of vision which from their position make an impression on the weaker eye alone, are really seen by it, and thus the visual field of the prevailing eye is completed in such a manner that we imagine we see by the prevailing eye all that we see only by the weaker eye, although we are completely conscious of the co-operation of the other eye. The deductions from the above experiments are confirmed by the following. For these experiments it is best to use the apparatus represented in Tab. VI.

This consists principally of a movable box C, which has placed upon it at right angles and in an oblique direction a frame destined to carry the board T, upon which the two lines to be observed are drawn, and which is fastened to a head A by a tenon B, in such a manner that to its upper surface C, any desirable elevation or depression may be given by means of the screws R and S. The little frame bears a movable arm E, which is furnished with a joint N, whose other piece V is made of cork, and has a needle F upon it for adjusting the eyes, when beholding the lines upon the plate T principally with crossed visual lines. If we place the surface C of the movable box horizontally (by means of a tube-libella) and put into the frame T a band upon which are drawn two perpendicular straight lines *a b*, as in Fig. 5, in such a manner that their centres are at the same level as the eyes, while we rest the chin upon the head A of the apparatus, or take the little board H between our teeth, and fix the point *a* with the right eye, and the

point *b* with the left, then both straight lines will coincide with one which lies (come together) *in the line of vision of the right eye.* The separate image of* a, *corresponding to the right eye, will be seen in its true place, that of* b, *corresponding to the left eye, on to the right of* a. In order to behold the same straight lines (Fig. 6, where they are marked with reversed letters) with crossed lines of vision, we give to the needle F, of the apparatus (Tab. VI.), such a position that the visual line of the right eye which passes through its head, strikes the point *a*, and the line of vision of the left eye the point *b*. If now we fix the head of the needle in such a manner that it is seen singly, we see then, coinciding with the needle and, as it were, prolonged from it, the united image of both lines *a b* in such a manner that it lies in the air at a distance from the board, while the separate images of these straight lines which are formed because the right receives also an image of *b*, and the left one of *a*, lie nearly in the level of the board, so, however, that that to the right of the united image lies somewhat more forward and to the right than the left separate image, which is more backward and to the left. We shall now consider further two systems, of two curves each, of which one is to be observed with direct and the other with crossed lines of vision, in order to obtain the corresponding horopter, by lines of direction projected into space. For the sake of

* If we look at two lines, straight or curved, which, by a proper position of the eyes, represent themselves upon identical parts of the retina, and which consequently by their outward projection unite in the horopter, we see three images, of which the middle one is the united or stereoscopic image, but the other two belong each to one eye, these latter I call the "*separate*" images.

explanation we will use Fig. 7, while the corresponding systems are represented in their true form in Pl. 2, and which may serve for observation if they are drawn on a window upon tissue paper and then transferred to a glass plate. The position of the eyes appropriate to system A (Pl. 2), may be determined in the following manner:—

If we imagine a line *a* drawn from the root *n* of the nose of the observer, and through Z (Fig. 7), and permit the board T, that is the plane of the curve, to stand normally upon the straight line *n z*, then the length of *n z* is 128.5 millimetres, the inclination of *n z* towards the horizon 20°, and the deviation of *n z* from the median plane towards the right 18°. By means of the apparatus (Pl. 1), it is easy to effect this position of the eyes. Place the little frame upon the hind pin V, of the box *e*, and give to this the necessary inclination of 20° below the horizon, then turn, elevate, or depress the little board II by means of the loosely adjusted rod T, in such a manner that it may be taken between the teeth, the face make an inclination of 18° to the right, and the eyes be in the same level with the line *a b* on the board T.* When you have taken the right position of the head, then fix the points *a* and *b* with direct or uncrossed lines of vision. In this way both curves will unite themselves to form the horopter, which *coincides with the curved line* a *upon the board.* Of the two separate

* It is necessary to give to the head a somewhat oblique position, to such a degree that we see the straight line *a b* singly. In order to effect this without being obliged to let go the little board which is held by the teeth, the rod I must have, immediately below the little board, a joint movable from side to side.

images, the left one which is seen with the right eye is in its true position, the right one seen with the left eye, somewhat farther to the right and a little in front of the surface of the board. If we turn the little frame D of the apparatus (Pl. VI.) around so that the arm E is directed backward, and make holes in the points *a* and *b* on the board, then we may place the needle in such a way that the two lines of vision passing through the holes intersect at its head. If we now fix the latter in such a way that both it and the holes in the board are seen singly, then the horopter recedes to the needle and appears firmly united with it, whilst the separate images remain close to the board, that of the curved line *b* in its true position, but that proceeding from *a* of the left eye removed towards the right.

The position of the eyes with crossed visual lines belonging to system B, Pl. VII., is determined as follows:* The distance $n\,z$ is 398.5 mm, the inclination of $n\,z$ towards the horizon 10°, and the deviation of $n\,z$ from the median plane towards the right is $21\frac{1}{4}$°. By means of the apparatus (Pl. VI.), it is again easy to obtain the required position of the head. The little frame D is here, as represented in the drawing, placed upon one of the anterior (not visible) pins of box *c*. In order to give to the eyes the suitable direction, we again bring the head of the needle to the required position between the board and the face. If we now fix the head of the needle in such a way that it appears singly, we

* In my treatise on the horopter, and the identity of the retina, I have given the elements of 130 positions of the eye, and have constructed the corresponding curves.

shall see the combined image of the horopter in its oblique direction pass through the head of the needle, and of both the separate images which lie in the surface of the board; that which belongs to the right eye will be in its true position, the left, on the contrary, somewhat nearer to the combined image and farther back. If the curved lines are drawn on a plate of glass, and we turn the latter around its horizontal mid-line, and place the apparatus in such a manner that the light passes through the glass before it reaches the eyes, leaving it in other respects unchanged, only giving the straight line $n\ z$ a lateral deviation of $27\frac{1}{4}°$ to the left, then we shall see the horopter again as a united image, intersecting the needle at a great distance in front of the plate, whilst the separate images lying close to the surface of the plate have opposite relations to what they had before, viz.: the right nearer to the right side but more backward, the left somewhat nearer to the left and rather forward. In both cases the separate image belonging to the right eye is on the right side, that belonging to the left on the left. The explanation of these phenomena is easy.

1st. By the union of the two straight lines with direct lines of vision, the image of b, Fig. 8, belonging to the left eye and lying in its line of vision, is transferred to the line of vision of the right eye, consequently the united image at a is seen opposite the right eye. The separate image of the right eye proceeding from b remains at b, but that of the left eye proceeding from a is, on the contrary, moved to a^1 into the angle $a\ o_1\ a^1 = \ < b\ o_1\ a$.

2d. By the union of the two straight lines with crossed

lines of vision the united image is seen at f (Fig. 9). The separate image from b of the right eye remains at b, the separate image from a of the left eye o_2 is seen at a^1, so that $<a^1 o_1 a = < b o_1 a$.

3d. The union of the horopter curves with the direct lines of vision (Figs. 10 and 11), as well as with crossed lines of vision (Figs. 11 and 12), is analogous as before; only that by the lateral deviations to the right (Figs. 10 and 12), angle V. $> w$, and with the lateral deviation to the left (Figs. 11 and 13), angle V. $< w$, from which it follows that the image to be seen by the right eye in its true position, lies farther from the united image at a than the separate image seen by the left eye at a'.

Experimenting with crossed lines of vision, one might, perhaps, become doubtful whether the united image lying near the face really appears in the line of vision of the right eye, and the right separate image in its true position, or whether, perhaps, it is not apparently seen by the cyclopean eye. But it is easy, however, to convince ourselves of the contrary, for in the latter case one would see both separate images, a^1 b^1 (Fig. 14), at equal distances symmetrically from the united image at f. This, however, is by no means the case, but we see the images at $b f a^1$ (Fig. 9), where they appear to the right eye o_1, the image a^1 lying farther to the left. I have yet to mention the following experiments which seem to me to confirm the theory of binocular vision above stated.

1st. If we unite stereoscopic images with parallel lines of vision (of course without a stereoscopic apparatus), then

the common stereoscopic image appears exactly opposite to the right eye,* where the right photographic image really lies, and the left separate image opposite to our left eye, where the left photographic image really lies, but the right separate one in the air lying so far from the right line of vision towards the right as the left towards the left.

If we, on the contrary, unite with crossed lines of vision, by adjusting the head of the needle of our apparatus, the little frame of which bears the stereoscopic image, so that the intersecting lines of vision will fall upon the identical places of the images, and fix the needle head carefully so that we only see it singly, then the stereoscopic image appears in similar relations, as the lines observed before with crossed lines of vision, but at the same time much diminished in size, probably for the reason that we believe the object to be nearer to us than it really is.

2d. If we fix with both eyes a red wafer, fastened on a dark background, and situated in the prolongation of our median plane, then we shall see its after image by plain parallel lines of vision opposite the right (or prevailing) eye.

3d. If we place two red wafers about two inches apart

* If we now, after the stereoscopic union of both images with parallel lines of vision has been accomplished, continue the same so far to the left, that the common image lies opposite the left eye, then the *middle of the common image always unites with the middle of the right photographic image*, and the left separate image with the left photographic image, while the *right separate image always lies to our right.* We here suppose that the right eye is the prevalent one. By this and the preceding experiments, one may easily be convinced that even those who think their eyes of equal strength, possess a prevailing eye. Indeed, no one can see the side image lying in the air anywhere but on the side of the prevailing eye.

upon black paper, and unite them with nearly parallel lines of vision, and then gaze with parallel lines of vision upon a sheet of white paper, held in readiness, we see the blue-green united after-image opposite to our right eye, and on both sides at equal distances, the after-images of the separate images formed upon the retina of each eye. To the above-described explanation of the act of binocular vision, is to be added that we have learned from childhood up to overlook the double image corresponding to one eye. The circumstances under which this oversight is most difficult or most easy, with fine objects lying close to the median plane, is not uninteresting. If f (Fig. 15) is a point at which the lines of vision of both eyes o_1 and o_2 intersect each other, and m, the place of a pin held out perpendicularly beyond our near point, we shall see a double image of m, *and both images are equally distinct if we accommodate for* f, *but the one corresponding to the weaker eye will be seen the least distinctly, if we, without changing the position of the eyes, accommodate for* m. The following experiment, also, corresponds with this. If we draw at the point a b (Fig. 16) two curved lines as marks, and mid-way between them a straight line, c, and then unite a and b with direct lines of vision, we see the line c and its double image c^1 with equal distinctness, while accommodating for the distance (*i. e.*, by relaxed accommodation), c, on the contrary, grows faint as well as the right separate image of the mark a^1, when we accommodate for the plane of the image, and c then appears the more distinctly. It is almost to be expected that these experiments will not give equally dis-

tinct results with all. I thought best, however, not to withhold those observations made on myself.

Finally I have to consider another phase of vision, as if it were a higher degree of the same, and in this I believe is to be found the justification of the cyclopean eye of Hering. If we consider the field of vision lying before us with quiet fixation, for a protracted period, and at the same time take into consideration the relative position of objects to our own self, we at once, without knowing it, use the left or weaker eye too as the dominating one, and survey the field of vision as it were from two stand-points. While thus alternately operating with both eyes, the idea of our field of vision is created in us, under the influence of many years' practice, as though we were seeing by means of the imaginary cyclopean eye situated at the root of the nose. This sensation is, however, according to my view, not immediate vision, but a psychical act, resulting from abstraction and reflection, receiving according to individual disposition, a more or less perfect development. The transferring of the image from the weaker to the prevailing eye, is, without doubt, a psychical act, but one which has become second nature to us, and which requires no reflection whatever, but bears the imprint of instinct.

CONTRIBUTIONS TO THE PATHOLOGY OF BURNS OF THE CORNEA FROM LIME.

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Translated from the German by Dr. Joseph Aub.

(See Plate III., Figs. 1–4, and Plate IV., Figs. 5, 6.)

Up to the present day the statements of the pathological changes which the cornea and the other portions of the eye undergo after a burning with lime are very scarce. This seems the more remarkable since the importance of this injury, and the difficulties accompanying the successful treatment of the same, stands in inverse proportion to the possibility of making experimental studies on it. We hope that the experiments and the pathologico-anatomical researches will enable us also here to find a way to diminish the dangers attending this affection, or even, under favorable circumstances, to remove it entirely.

We can, at least, with some degree of certainty, expect that the experiments will give us some results as to the

anatomical changes caused by the influence of the lime in the tissue.

Before I commence with the results of the experiments made by me, permit me to give you a short historical review of that which has been done in this field, and then I will explain the clinical as well as the pathologico-anatomical part of my work, and will close with a few remarks on the therapeutics of this affection.

All authors whose testimony I have been able to collect agree in this point, that the burnings with lime belong to the most dangerous affections, and should be placed in the same category with the cauterizations with the mineral acids, but are distinguished from them by the opacity which remains behind.

I will confine myself to the citation of those authors alone who mention something new on the subject.

Rosas* makes the following remarks on this subject: "Unslaked lime, especially when it is slakened on the eye itself by the careless and rapid use of water, is often so destructive that the cornea is totally dissolved and changed into a greyish-colored mixture, which can be washed with a small pencil from the iris. Generally, however, such a positive decomposition of the cornea occurs only in single portions of this membrane, and often only superficially. However, you can always prognosticate a white, shining cicatrix where you find a depression in the cornea immediately after

* Handbuch der therapeutischen und praktischen Augenheilkunde, Bd. II. Wien. 1830, pag. 642.

the burning. Slaked lime only produces a superficial cauterization, or causes a coagulation of the lymph circulating between the lamellæ of the cornea."

Chelius* mentions the subject thus: "Escharotics which work chemically on the eye change the habitus of the corneal tissue, and by the coagulation of the same give the cornea a white and opaque appearance, as if it were covered with a white membrane; for instance, in cases of burning with lime. Mineral acids and their vapors have the same effect."

Arlt† makes the observation that the burning with lime produces a severe inflammation, that the same is followed by an opaque cicatrix, and that the deeper ulcerations can be accompanied by iritis, hypopium, &c., &c.

Ruete‡ compares the cauterizing power of the lime with the other chemical substances, as sulphuric acid, &c., and believes that the cornea and sclerotica offer so much resistance to the lime that it is very seldom that either of these membranes is perforated. His opinion of the resisting power of these membranes he bases especially on the following case, described by himself: "I found in the eye of a mason a piece of lime as large as a pea, which had fallen into the eye the day before. It had eaten its way through the conjunctiva up to the sclerotica; the whole conjunctiva was inflamed in a high degree, but the sclerotica in the spot where the lime lay was perfectly white and healthy."

* Augenheilkunde. Bd. II., pag. 520, § 630. Stuttgart, 1839.

† Die Krankheiten des Auges, Bd. II., 3. Abdruck, pag. 207. Prag., 1855.

‡ Lehrbuch der Ophthalmologie. Bd. II., pag. 354. Braunschweig, 1855.

V. Graefe* gives a very precise clinical picture of this affection of the eye, and believes that the white opacity of the cornea is kept up in a directly chemical manner. I shall very often refer in this article to the opinions expressed in V. Graefe's paper.

In describing symblepharon (anterius) nearly all authors mention the burning of the eye with lime as one of its most frequent causes; but since my experiments were almost exclusively confined to the cornea, I can only in a few words mention the changes in the conjunctiva, and especially in the limbus conjunctivæ.

In the commencement of my experiments I deposited a little lime either in the upper or lower conjunctival pouch of a rabbit; however, I soon changed my manner of proceeding, in order to be able to study more minutely the pathologico-anatomical changes. I had a small speculum made in order to open the eyelids as far as possible, and then cauterized the cornea by means of a glass tube of moderate size which was filled with quicklime. Thus I could regulate the working of the cautery, either making it stronger or stopping its further destructive powers by allowing it to remain, or removing it immediately after the cauterization.

The rabbit appeared to me, at first, to be best suited for my experiments; but I soon convinced myself that the dog had the same advantages as the rabbit.

After cauterization of frogs' eyes I could not find this

* Arch. f. Ophth. Bd. II., Abth. I., pag. 235.

deep, opaque coloring, but only a greyish, cloudy opacity, with loss of epithelium, which regenerated very slowly.

CLINICAL PART.

It is a well-known fact that the symptoms vary greatly according to the condition of the lime, *i. e.*, whether it is dry or somewhat damp, and according to the period that it has its influence on the cornea. If you apply unslaked lime to the cornea of a rabbit in the manner above described, and then dampen it, you will notice that the cornea will be dry in a few seconds; furthermore, that the pupil will be strongly contracted even there where it had been dilated by atropia, and that the animal attempts with the secondary lid to remove the foreign body. Should you remove the lime in the course of ten or fifteen minutes, and with it the epithelium by means of some water or oil, you will observe a milky-white circumscribed opacity, whose surface, observed with the naked eye, appears smooth and shining, but if examined with a magnifying glass, is rough and uneven.

The conjunctiva bulbi et palpebrarum becomes swollen, and the subconjunctival vessels, especially in the vicinity of the superior rectus, begin to be injected.

On the following day you notice some secretion, and the white spot is surrounded by a cloudy opacity, which gradually disappears towards the periphery. On the third day the subconjunctival injection is increased, and the entire cornea cloudy. About this time the boundary line of that

portion which was robbed of its epithelium is lost, and the previously shining opacity has a totally dull white appearance.

After three or four days the spot commences to suppurate, and you can remove from the same small portions in shreds. The periphery of the cornea gradually clears up as the injection of the vessels recedes.

The opacity observed around the cauterized spot remains, and may even appear more intense ; the cauterized portion itself seems somewhat clearer and bluish-white ; at the same time the epithelium commences to regenerate itself from the periphery, and thus the spot becomes shining and of the same height as the surrounding parts. This generally lasts from fifteen to twenty days. This definite opacity is not so extensive as in the commencement, and is more intensely white.

At this time this spot is perfectly sensitive. I have had the opportunity to observe these opacities for months, and could remark that no more changes took place after the fortieth day, and the opacity was always of such a kind as described by all authors.

The process does not take this comparatively favorable course if the remains of the epithelial layer of the cornea are not removed with the lime in the beginning, or if the conjunctiva and the cornea are cauterized at the same moment. In the first case, the thing is not so simple ; on the contrary, the opacity appears much duller and more dense, and the surface is rough, but as unsensitive as formerly. As soon, therefore, as the inflammatory process has

reached its maximum, an ulcer with chalky white foundation makes its appearance, sharply defined from the surrounding opacity. The ulcer advances slowly, with occasional exacerbations of the inflammatory process, indicated by the increased subconjunctival injection. The cloudy neighborhood is also extended, and more dense, and sometimes abscesses are found in it. After five or ten days we have the same picture presenting itself to us as that which V. Graefe has described, as follows: "Finally, when only one fine layer remains, the cornea receives that traitorous transparent appearance so often seen in diphtheria; the iris appears as if viewed through a bubble of absolute transparency."*

If no perforation ensues, the cicatrization commences slowly, and in such a manner, as is evident from my microscopical observations, that the milky white spot is covered by the cicatricial tissue.

The consequences of a burning with lime appear so much worse when the conjunctiva takes an active part in the process, and especially V. Graefe attaches great importance to this circumstance. The cauterized spot assumes in this case a whitish yellow color, and the vascular portion, as for instance the limbus conjunctivæ, appears of a yellowish green color, so that these differ greatly, as regards their color, from the white opacity of the cornea.

If the lime is not soon removed, the cauterized portion will soon be covered by the swollen conjunctiva; besides

* Loc. cit., pag. 236.

this, the cauterized portion of the conjunctiva is also contracted, and lies so firmly adherent to the sclerotica that it can not be moved on the eyeball. The inflammatory process is very vehement, and combined with considerable secretion from the conjunctiva.

The cauterized portions have, almost from the commencement, a whitish color mixed with small ecchymoses. After 8 to 14 days, according to the duration of the cauterization and the vascularity of the cauterized spot, the same begins to be cast off in scales, and a large amount of granular tissue is developed, which, from its aptness to join the palpebral conjunctiva causes the conditions known long since as symblepharon, &c., &c. In this stage I noticed that a vascular net was formed on the cornea which anastomosed with more or less strongly injected conjunctival vessels.

At the same time the cauterized portion of the cornea began to cast itself off in shreds, which almost invariably led to perforation and prolapsus of the iris, purulent infiltration of the neighboring portions of the same, iritis, hypopium, &c. Then the newly formed superficial vessels disappear gradually, and in their place finer but more deeply situated vessels appear.

About this time you can also observe folds of the conjunctiva stretching towards the cauterized portion of the cornea (false pterygium). They often connect themselves with this, and then they form a true pterygium. The cicatrization meanwhile takes its common course, and we finally have all those unhappy results of symblepharon anticus, entropion, permanent opacity of the cornea, &c.

It is well known that slaked lime also causes a cauterization which is only distinguished from that produced by unslaked lime by its much more diminished intensity; I have, in order to note the difference, several times used the common builder's cement, and convinced myself that it only needs a longer influence to produce the same result.

I have had the opportunity to observe, during the winter session of 1868-69 in the clinic in Heidelberg, two cases of burning of the eye with lime. The one was of old standing, and came for relief from a consecutive symblepharon and an almost total diffused opacity of the cornea of the left eye.

The other case, which came to the clinic the day following the accident, resulted favorably. The patient was a mason, and said that he had immediately removed the slaked lime from the eye by means of an acid solution (?). On the conjunctiva palpebræ superioris we observed a cherry-sized scab of a whitish yellow appearance, with some small ecchymoses. The lower portion of the cornea was also affected to a similar extent, deprived of its epithelium, and the surface diffusely opaque. With the aid of atropia and pressure bandage the epithelium was soon restored, and the patient was dismissed after four days with but a small opacity on the injured spot. About this time the superficial scab of the conjunctiva had been cast off, and showed a good granulating surface.

MICROSCOPICAL PART.

The pictures which presented themselves to me in my researches were very different, influenced by the seat of cauterization, *i. e.*, whether the conjunctiva or cornea was cauterized ; further, by the duration of the cauterizing effect of the lime, and finally, by the period in which the cauterized portion was examined.

A large number of the eyes were hardened in alcohol. In the beginning I confined myself to this means of hardening, and avoided acids of a dissolving effect on the parts which might contain lime; later, however, I also used other methods, which I will hereafter mention.

After one or two days' preservation in alcohol, the cornea has such a consistency as to allow of the finest microscopical cuts, especially if embedded in parafine.

The examination of corneæ immediately after cauterization, shows the following: The epithelium is totally destroyed on the cauterized spot, and where it has not been removed, we find it replaced by a more or less coarsely grained mass (Plate III., Fig. 1, *a*), mixed with very many comparatively large particles of lime.

After removing the epithelium we find the cornea, at the cauterized spot, shining white, and thinner than the sound tissue. On very fine perpendicular cuts of this membrane, you can see with a small magnifying power, that the opacity, whose depth is dependent on the duration of the influence, and which can therefore embrace the whole thickness of the cornea with the Descemetii and the epithe-

lium is more or less uniform, and by transmitted light appears brown or blackish, whilst by incident light it appears of a perfectly snow-white color. If we use greater magnifying powers, we observe that the spaces occupied by the corneal corpuscles are smaller than in the sound cornea and appear contracted; further, that the opacity is caused by a dusty-like substance whose grains are unusually fine and numerous, and are therefore difficult to be seen even with still greater magnifying powers. If we apply acids, for instance muriatic or acetic acid, we observe that this substance disappears with the evolution of more or less gas, and thus the cornea again becomes clear. In using sulphuric acid the opacity also disappears in the same manner, and numerous needle-shaped crystals are formed which collect in star-shaped groups (gypsum, *i. e.*, sulphate of lime).

Whilst the corneal layers swell on the use of acids and become transparent, the corneal corpuscles become more distinct and have the appearance of being clouded by granules.

What has just been described, has also been confirmed on microscopical sections made parallel to the surface of the cornea, with this single difference, that we could observe more distinctly the corneal corpuscles and their nuclei; the latter offering nothing abnormal.

Since it was often observed that the cornea was affected in its entire thickness, it was natural to examine the aqueous humor for its amount of lime.

In order to obtain the latter pure, I used a lance knife

invented by Ed. Jäger for this purpose, one surface of which had an aperture communicating by means of a metallic tube with a glass cylinder. I almost always waited some length of time (12–14 hours) after the cauterization, then I punctured a portion of the cornea which was still healthy with the lance, and pushed the latter forward until the opening was in the anterior chamber. Then the contents flowed through the opening into the glass cylinder, perfectly clear, and when exposed to the air, partially coagulated. At this period, the aqueous humor shows under the microscope a variable number of pus corpuscles, which for some length of time allow the changes in their form and locality to be easily recognized.

When sulphuric acid was added, many crystals of sulphate of lime were precipitated. The lime is generally found after coagulation to predominate in the coagulated fibrine, and is therefore peculiarly well adapted for this test. In other cases the loss of clearness and the formation of coagula in the aqueous humor, occurs before the latter is drawn off from the anterior chamber. The pus corpuscles had nothing abnormal, and the use of sulphuric acid occasioned in the beginning only a destruction of the protoplasma, so that, after its influence, the nuclei were, for a period, completely isolated and intact. The examination of the cornea, from one to two days after cauterization, differs only in the presence of a larger or smaller number of round cells, with one or more nuclei, in the periphery of the cornea and around the opacity. Especially in the periphery of the cornea they are arranged in rows between the corneal

lamellæ; later, we find them, varying in number, at the cauterized spot. In order to recognize the arrangement of these cells, I first used carmine, but because the protoplasma of the corneal corpuscles could not be plainly seen in this manner, I employed the method described by Cohnheim in his reformatory paper on Inflammation and Suppuration.*

Before, however, I had decided on this method, I had with much confidence tried the method lately recommended by Leber.†

Having had the best results from it on the healthy cornea, I was greatly astonished to find that in this case it was perfectly useless, as well immediately after cauterization, as during the period of cicatrization. The cauterized spot does not become impregnated, and the beautiful negative pictures of the corneal corpuscles appear only in the sound portion.

Then I tried Cohnheim's method, and succeeded admirably, the preparations were excellent, the fixed corneal corpuscles could be distinguished from the wandering, and the finest branches of the nerves were visible. This method has but one objection, and that is, that we must use an acid, although only in a highly diluted condition; but since I had already convinced myself of the presence of lime in the cauterized spot, it did not matter much whether the lime was dissolved, &c., &c.

A preparation treated according to Cohnheim immediately

* Virchow Arch., Bd. 40, page 1.

† Arch. f. Ophth., Bd. 14, Abth. III., page 307

after cauterization, shows a diffuse blackish color, after metallic reduction at the place of cauterization ; the corneal corpuscles are very small and appear contracted, especially if compared with those lying in their vicinity. These again appear large when compared with those in the healthy tissue, and this may be explained by the imbibition of albuminous material. The corneal corpuscles of the cauterized portion color but little ; their margin is indefinite and only to be known by a row of small black dots ; those lying deeper are more easily recognized. Sometimes, we also see nerves in the cauterized portion, but only the thickest branches, and they have the same granular appearance that I observed in the corneal corpuscles.

The preparations of peripheral parts of corneæ which were cauterized 12–24 hours previously, show those round cells with one or more nuclei arranged in the same manner, as has already been described by Cohnheim. It was only seldom that I could convince myself of the presence of lime in the corpuscles. I took care not to draw any conclusions from this fact, in the gold preparations, because the use of tests can never give a reliable result in this direction.

Further on, I will mention the results which I derived from the gilding of the definite opacity ; now, I will return to the other form described by me, namely, to that in which the mass of epithelium, mixed with more or less large particles of lime, was not immediately removed, and where, in consequence thereof, the opacity takes that chalky white appearance which it presents during the process of ulceration and cicatrization. In this case we observe, besides the

above-described changes, an increase of thickness and an apparent petrification of the cornea.

Plate III., Fig. 3, represents a preparation of a cornea, whose centre presented, six days after cauterization, the described changes. In Fig. 2, the change from the cauterized to the sound tissue of the same object is delineated. From these drawings you can convince yourselves that the entire substance of the cornea (Fig. 3), and especially the layers of the same are filled with small granules which gradually disappear towards the periphery. Next to this abnormal tissue comes one less changed, which denotes the beginning of the process of regeneration, and then the epithelium (Fig. 2, *a*).

The petrified portion of the cornea is, especially after hardening in alcohol, peculiarly brittle, and in directing the cuts we have a feeling as if cutting something of a sandy nature.

I could observe in corneæ, with these changes, which I had watched for a length of time, that the petrified portion was totally covered by a newly formed tissue. This portion, as is easily believed, reacts to the test very strongly, and with the escaping of much gas (carbonate of lime). The granules disappear, the tissue is clear, and you can distinguish the layers and the corpuscles. In cases where the ulcerative process reached a considerable depth, I could observe, on the inner surface of the Descemetii, a layer of newly formed tissue, which presented, on perpendicular sections, much similarity to the corneal tissue. The endothelium covered the inner surface of this tissue, which

seemed to be shoved between it and the Descemetii, and whose periphery gradually lost itself in the endothelium of the Descemetii.

The observation has already been made by Donders, in his work called "Neubildungen von Glashäuten im Auge,"* and is represented in the accompanying Fig. 5. The only difference is that, in the cases observed by me, the newly formed tissue corresponded to the cauterized spot, and that between the same, and the epithelium covering it, as yet no newly formed glass membrane existed.

The lime causes great changes as well in the conjunctiva and sclerotica as in the cornea. The former seems peculiarly adapted to these from its anatomical structure. I have convinced myself of this, that even in cases where the conjunctiva has been but little cauterized, a large amount of lime has been taken up in the wide meshes of the episcleral tissue. The lime is found in the same in the shape of large globules (Plate III., Fig. 1), which can keep up an irritation of this and the surrounding tissue for some time.

The sclerotica itself does not absorb much lime immediately after the cauterization. However, it seems that the particles of lime, after having produced a violent inflammation with inauspicious results in the conjunctiva, may advance further and penetrate even into the sclerotica in considerable quantity.

I must briefly mention two very interesting conditions,

* Arch. f. Ophth., B. 3, Abth. 1., page 163.

namely, the infiltration of the sclerotica with lime in spots corresponding to the insertions of the recti, and the formation of sequestra at the cul-de-sac of the conjunctiva. The former occurs in such a manner that the entire tendon is petrified. The latter appears in the form of a piece of tissue, variable in size, which is completely petrified, and is detached from the neighboring parts, so that we can properly call it a petrified sequestrum (Plate IV., Fig. 5). In the same figure you can see the arrangement of the newly formed vessels. Some lie directly under the epithelium, and are in connection with those of the conjunctiva (*b*), the others are deeper, and seem to be a continuation of the subconjunctival vessels.

These two classes of vessels are in connection by means of anastomosing vessels.

Especially in the vicinity of larger vessels a considerable quantity of small round cells, with one or more nuclei, may be seen, which often contain a variable quantity of lime.

The granular tissue which takes the place of the detached portion of conjunctiva or cornea, contains the most lime. I have also observed more or less lime in the muscular fibres lying under the cauterized spot.

I must now speak of the results which I derived from the microscopical examination of the corneal opacities left after cauterization.

Under this head I consider all such, where after a period of from one to two months the opacity had not changed, and where the epithelium and Bowman's membrane had regenerated.

The examinations were made, as formerly, on alcoholic and gold preparations. The cornea was found thicker than usual on the cauterized spot, and this increase generally occurred in the direction of the anterior chamber. Perpendicular sections showed us that the epithelium, and especially the substantia propria of the cornea contained a variable quantity of small particles of lime.

The cells are more numerous on the spot where there has been a loss of tissue. This portion is distinguished by lines of spindle-shaped cells, or of such with several communicating processes ; some of these have even a very deceiving resemblance to the fixed corneal corpuscles, with this difference, that they are more numerous, and that their projections are comparatively thicker, and also that their course is more irregular, so that the intercellular substance is not represented as in a normal cornea by lamellæ, but by a regular areolar mass which resembles the intercellular substance of the cicatricial tissue (Plate IV., Fig. 6, *c*).

The perpendicular section of the gold preparations (Plate IV., Fig. 6) is very instructive. In the case described there, the cicatrix takes up about half the thickness of the cornea. This portion has acquired a dark violet color from the gilding; we see how it diminishes in thickness, and gradually terminates in a well-defined line. Posteriorly, the cicatricial tissue gradually loses itself in the comparatively normal corneal tissue ; anteriorly it advances to Bowman's membrane, where centrally situated papillary prominences are seen : then comes the membrane

just mentioned (*b*), which is here somewhat thicker than at other places ; and finally the newly formed epithelium with a smooth and regular surface (*a*).

It is a very interesting fact, that completely developed nerves can be found in the cicatrix, which they traverse in different directions, and which can be found ending in the epithelial layer (*d*). In some opacities, whose regeneration was not yet completed, we could see, in the most superficial layers of the cicatrix, a large number of spindle-shaped elements standing closely together.

Longitudinal sections seem peculiarly favorable to the study of the form of the cells, and the communication of their processes. In the sections we can convince ourselves of the fact that they have the greatest resemblance to the normal corneal corpuscles.

The other half of the cornea, which had been hardened in alcohol, showed that the largest amount of lime was generally found in the neighborhood of those rows of cells which I have described as the cicatrix. The regenerated epithelium, which covers the cicatrix, as well as the corneal substance posterior to it, also contained some lime, although not so much. The test with sulphuric acid showed in this case a total disappearance of the lime granules, and a considerable precipitate of crystals of sulphate of lime with a little evolution of gas.

Whether the regenerated nerves also contained lime, I can not say, since I could only see them in gold preparations; I consider it, however, improbable. As regards the glass membranes, they were free from lime. The membrane of

Descemet contained in some cases (Plate III., Figs. 2 and 3) small granules of lime.

THERAPEUTICS.

The occurrences above described, of course, led me to experiment, and see whether I could clear up the opacity on living animals by a methodical use of acids; this had already been tried, by various authors, on man, and by *V. Graefe** on animals without satisfactory results. I am very sorry to say that I am also unable to mention any favorable results. I used various acids (chromic, muriatic, and acetic acids) in very strong dilution, without having been able to notice any diminution in the opacity, after several weeks' treatment; but I have not yet given up all hopes on the subject.

Another proceeding which gave better success, was the abrasion of the cauterized portion immediately after the cauterization. I succeeded in this manner really in an astonishing degree, especially if I was able to abrade the entire dimmed portion.

In such cases, the complete regeneration of the removed portion took place in a very short time, and with perfectly transparent tissue, which fact had already been

* V. Graefe writes: Chemical antidotes, as for instance, the careless and not recommendable washing of the eye with diluted vinegar, could, perhaps, have some influence on the portion of the lime not yet in combination; however this can be better removed mechanically or involved with oil. At all events, we could only use it once, for the vinegar irritates the eye very much. These remedies have no influence whatever on the opacity already existing, of which fact I have convinced myself by experiments on animals (loc. cit., page 238).

confirmed by Donders, by experiments on animals, and by other authors on man. But this remedy, which seems very good for exceptional cases, where the cauterization is confined to a very small portion of the cornea, can not be thought of in cases of burning of the entire cornea, or in such where the entire thickness of the cornea is affected. This fact proves, however, that the lime which was found in the cicatrix, and occasioned its specific opaque character, must have been furnished during the cicatrization by those particles of lime which had pushed themselves forward into the substance of the cornea immediately after the cauterization.

From that which has been said, I believe myself justified in drawing the following conclusions :—

1. The first change brought about by the burning of the cornea with lime is a destruction of the epithelium, the remains of which, mixed with a large quantity of lime, form a detritus.

2. If the lime has remained for a short time in contact with the cornea, it not only causes a more or less deep destruction of the substance of the cornea, by the rapid withdrawal of the fluid with which the cornea is impregnated; but it also penetrates in variable quantity into the substance of the cornea in the shape of small, dust-like particles.

3. A large portion of the cauterized tissue is cast off during the inflammatory process, and is replaced by a cicatricial tissue containing lime.

4. If the destroyed epithelium, mixed with lime, is not immediately removed after the injury, it happens very

often that a true petrifaction of the substance of the cornea, besides the changes caused by the cicatrix, takes place.

5. The substitution of the detached corneal tissue is brought about by a cicatricial tissue, which is very cellular, and whose cells anastomose with one another in every possible way.

6. The cicatrix contains nerves which show the same anatomical arrangement as in a normal cornea, and whose terminations can also be followed into the epithelial layer.

7. If the cauterized portion of the cornea is removed, a white opacity does not result; on the contrary, the substituted tissue is clear and transparent.

8. In cases of burning of the conjunctiva with lime, the lime advances with ease into the episcleral tissue, in the form of globules of different size, which can at a later period form extensive incrustations on the sclerotica and the adjacent muscles, and thus increase the danger of the injury.

9. The opaque white and irremovable cloud is, at least for the greater part, occasioned by the presence of lime in the cicatrix.

In conclusion, I express my best and warmest thanks to my highly respected teachers, Prof. J. Arnold and Prof. O. Becker, for their friendly aid.

Explanation of the Figures in Plates III. and IV.

PLATE III.

Fig. 1.—Cornea, sclerotica, conjunctiva, &c., immediately after cauterization.

H. Cornea impregnated with minute particles of lime.

S. Sclerotica.

N. Plica semilunaris.

a. Epithelial detritus of the cornea, mixed with lime.

b. Particles of lime between the plica semilunaris and the sclerotica.

Fig. 2.—Cornea, six days after cauterization, incrusted with lime.

a. Anterior epithelium.

b. Corneal substance impregnated with small lime granules.

c. Membrane of Descemet.

Fig. 3.—A piece of the centre of the cornea of the same case.

b. Posterior portion.

Fig. 4.—H. Cornea.

C. Conjunctiva.

C′. Subconjunctival tissue impregnated with globules of lime.

M. Insertion of the muscular fibres and a rectus muscle on the sclerotica.

S. Sclerotica.

d. Membrane of Descemet.

u. Infiltration of lime in the tissue at the corneo-sclerotical juncture.

I. Iris.

Plate IV.

Fig. 5.—H. Cornea.

a. Epithelium.

b. Newly-formed superficial corneal vessels.

c. Newly-formed deep-lying corneal vessels which, especially in

d. are surrounded by many cells.

C. Conjunctiva.

e. Vascular net of the conjunctiva.

b. Subconjunctival vessels.

M. Muscular insertion of a rectus in the sclerotica.

S. Sclerotica.

V. Petrified tissue in corneo-sclerotical juncture.

I. Iris.

Fig. 6.—Corneal cicatrix, two months after injury, treated with chloride of gold.

a. Anterior epithelium.

b. Bowman's membrane.

c. Cicatricial tissue.

d. Nerves of the cornea.

e. Membrane of Descemet.

f. Endothelium.

THE GALVANIC REACTION OF THE NERVOUS APPARATUS OF HEARING, IN CONDITION OF HEALTH AND DISEASE. CONTRIBUTIONS TO ELECTRO-OTIATRICS.

By Dr. W. ERB, Professor in Heidelberg.

Translated by J. H. Pooley, M. D., of New York.

It might be supposed that a work so full of care, and earnest effort, and of such constant and consistent results, as that of Brenner on Electro-otiatrics,* would on no side be open to serious contradiction, least of all on that, in the special interest of which the work was undertaken. Nevertheless, the phenomenon so often recurring in the history of the galvanic irritation of the acoustic nerve repeats itself again here; the observers who next undertook these researches have conducted their examinations with but little skill, and arrived at only negative results. Instead of finding the reason for this in their own unskillfulness, they preferred to declare the well-founded matters of fact, which

* R. Brenner.—Researches and Observations in Electro-therapeutics. 1. On the effects of the electric current on the auditory apparatus in healthy and diseased conditions. An attempt at founding a System of Rational Electro-otiatrics. Leipzig, 1868.

Brenner had advanced, erroneous, if no worse. They even went so far in their holy zeal, as to deny the importance of the unassailable propositions of rational electro-otiatrics for the cure of aural diseases, and yet at the last meeting of the Society of Natural History at Dresden, it was seen from what a one-sided stand-point, and with what poor reasons a certain party opposed the clearest and simplest researches of Brenner, and the inferences which they lead every scientific critic to form. If observers to whom the application of the galvanic current to the finer electric researches of the nerves of the human body is an unaccustomed task, and therefore can not be easy, have not succeeded in their experiments on the galvanic excitement of the nervous apparatus of hearing (which even in the healthy often presents great difficulties), it is easy to explain, and may be pardoned, although a little more modesty in judging of these disputed questions would have been desirable; it is, nevertheless, very unpleasant when people who have made experiments with electricity the business of their lives, have in similar experiments met with like failure.

Even Brenner's researches have not wholly escaped this depressing experience: there are electro-therapeutists who are possessed of the enviable courage to declare, notwithstanding such positive and so many times publicly demonstrated results, that they have found it impossible to excite the nervous apparatus of hearing to its specific functions by the galvanic current; from which, in the belief of their own infallibility, they have drawn the inference, that such excitement was really impossible, in other words, that

Brenner knowingly or unknowingly had deceived the scientific world.

In spite of all this, in spite of all the verdicts given by modesty or arrogance, Brenner's results are in their principal points correct throughout, and, with some skill and practice, may be constantly controlled and produced; indeed they have already been confirmed by a few observers in many points. It depends evidently only on the imperfection of the method, or unskillfulness in the application of the galvanic current, that many observers only arrive at negative results. *Those who deny the existence or the correctness of the matters of fact discovered by Brenner, are simply in error.* To prove this, or at least to produce some of the material necessary for the proof, is the purpose of this essay. I publish the same only in the interest of the thing in hand, the bearing of which appears to me of such importance for the electro-pathology of the nervous system, without considering otology, that every effort ought to be made to confirm, beyond a doubt, the fundamental principles here in question. My paper makes no further pretension except to confirm and illustrate, as far as possible, the results obtained by Brenner; it does not yet reach any further than the results he has brought forward.

Stimulated by some unpleasant assertions not at all honorable to their originators, which I have heard in Dresden, and by the conviction already produced by preceding observations that Brenner's assertions are for the greater part true, I have undertaken a more extensive series of experiments, the results of which I hereby publish.

I hope that there will be found in my position, which is unconnected with the efforts of aural surgery and particularly individual aurists, on the one side, as well as in my occupation for many years with electro-therapeutics and neuro-pathology on the other, sufficient guaranties for the reliability of the results which I shall communicate in what follows. These are, as I remarked at the beginning, in all essential points confirmatory of the assertions of Brenner, regarding physiological relations, as well as the few pathological cases which have occurred to me so far.

I will first communicate the results of experiments on physiological irritation, because they are from my standpoint of the greatest interest, and have, until now, been the least confirmed; then I shall add the report of some pathological observations which have come in my way.

THE GALVANIC IRRITATION OF THE NERVOUS APPARATUS OF HEARING IN A PHYSIOLOGICAL CONDITION.

It is no doubt correct, from a purely scientific standpoint, that when an agent is recommended as a remedy, it is of the first importance that its physiological rationale be understood.

From this it is justifiable to make the effort to discover such a physiological basis, but the therapeutic application is by no means dependent on the discovery of such a basis. One must not, therefore, reject the galvanic current as a curative means for certain nervous diseases of the ear,

because some aurists have not succeeded in bringing the normal acoustic nerve to a reaction in accordance with known laws. How many of the remedies in use in aural surgery, particularly in nervous affections of the ear would remain, if before admitting them we should rigidly exact a physiological reason or basis for their use? This physiological basis is by no means easy to determine with justice in dealing with the nervous apparatus of hearing, as I have often been convinced. Nor should we *a priori* have expected it to be otherwise. Few nerves of the body are surrounded with so many impediments to the application of the galvanic current, almost everywhere a very dense substance of bone is the medium of conduction; the dry membrane of the tympanum, the air-containing cavity of the tympanum, which is only bridged over by the little bones of the ear, are great hinderances to the passage of the galvanic current, especially to a current of so little force as can, in the nature of things, be applied to the head. It may, therefore, be *a priori* expected that in many cases only with difficulty or not at all, will it be possible to excite galvanically the nervous apparatus of hearing; that, furthermore, manifold apparently abnormal phenomena will arise on account of the complicity of the given relations; nevertheless, from a great number of cases, certain legitimate rules of conduct may be deduced. How much more favorably are most of the motor nerves of the body situated for the influence of the galvanic current! And yet every one who has only occupied himself superficially with such researches knows what enormous differences they show in

regard to their galvanic excitability; how difficult it is with some individuals to prove clearly the law of contraction of the motory nerves. And yet no sensible person will deny that the motor nerve reacts on the galvanic current according to a certain law. Even in regard to these every-day repeated observations on the motor nerves, it must appear perfectly remarkable with what clearness and regularity the phenomena of excitement present themselves in the nervous apparatus of hearing. From this may be deduced the simple rule not to expect and force a favorable experimental result from every single case, and not to deduce from single failures the impossibility of representing in any degree these phenomena of excitement in a legitimate and determined formula.

I shall now be obliged to occupy myself in what follows with the technical difficulties of galvanic excitement of the acoustic nerve, and shall point out, somewhat in detail, the means by which they may be overcome.

I shall not have to say much that is new with regard to the precise method of producing the excitement. I am sorry that the account will have to deal with a multitude of technical details, but I hope by this means on the one side to make easy to my successors the statement of the more important results, and again to give some information to those who have not been successful in their researches with regard to the causes of the failure of their experiments. I hope by this means to convert the doubting or skeptic. I used, in most of my experiments, very imperfect apparatus, for it was only towards the end that I

obtained a "Rheostat," and a "Siemens-Halske's commutator."*

Nevertheless I have generally attained my end. I have commonly used a Stœhrer's battery with a closing bar, in which the number of elements could only be changed by two. The closing and opening of the current was accomplished by hand, with a wire immersed in mercury, changing the direction of the current with a metallic commutator; where in the following statement it reads *Volt. Alt.* (voltaic alternatives), it signifies a rapid change in direction of the current with the closed chain; where simply turning of the anode or kathode is mentioned, the current was first

* I will insert here a few remarks for such as use this apparatus; it may perhaps be useful. The commutator or current-turner is, especially in Brenner's new form, exceedingly convenient and useful. It serves, at the same time, for the interruption and closing of the current, and permits the slow and quick entrance of the voltaic alternatives. I am exceedingly satisfied with this apparatus. I was not so at first with the Rheostat, as long as I used it in a Stœhrer's battery with the old cylindric elements. I was not then able to effect a sufficient diminution of the current with the Rheostat alone. As even six and four elements, with only ten resistances in the secondary closing with me, and some of my patients with hyperæsthesia of the auditory nerve, produced sensations of sound. But for two days I have used one of the new Stœhrer's batteries, with plate-elements, and I am now perfectly satisfied with the operation of the Rheostat, and find it quite in accordance with Brenner's assertions. I am inclined to refer the effects to the different sizes of the surface of the elements in the two batteries; for if I with the cylindrical elements (which have a much larger surface) close and open the current, at a certain intensity, lively sparks are produced, while in the batteries with the plate-elements, with the same number of elements, and the some physiological conditions (*i. e.*, the same intensity of current by inserted great resistances of conduction), at the metallic interruption none, or only quite weak sparks are observed. This must be further investigated. I will only, in passing, make these remarks, to save others who, perhaps, may have some difficulty, trouble, and vexation over the apparently insufficient operation of the Rheostat. With a battery of elements with relatively smaller surfaces, the same appears to be an excellent means for the graduation of the intensity of the current.

opened in one direction, then the commutator transposed, and then again the chain closed in the now altered direction. The galvanic excitement of the acoustic nerve presents, in many healthy persons, very considerable difficulties. One of the greatest hinderances to the success of the attempted experiment is pain, which is particularly severe if we introduce the ear-electrode into the auditory passage when filled with salt water. The pain then quickly increases, even with a current of moderate intensity, to a degree altogether intolerable; this I have repeatedly experienced in my own person; and if, notwithstanding, I continued the experiment, slight attacks of syncope occurred.

A very high degree of sensibility of the auditory meatus and membrana tympani occasionally manifests itself, especially with individuals of a superior degree of intelligence; we meet with this hyper-sensitiveness also very frequently if we touch the sides of the meatus or the membrana tympani with a probe or some other instrument.

In persons suffering from aural disease, this sensibility is far less manifest: partly, perhaps, because it has been blunted by numerous manipulations; partly, also, on account of anatomical changes in the tympanum; or, lastly, because the walls of the auditory passage have been changed in a favorable manner by the long-continued application of astringents. So far no expedient has been discovered to obviate this manner of application from pain, and very short sittings are all that can be borne, by which, however, some very characteristic phenomena are lost. The pain is

greatly moderated if, following Brenner, we place a somewhat larger electrode upon the tragus, and by this means close hermetically the auditory canal which has been previously filled with salt water. In this way the pain is localized upon the external integument, and thus much more bearable; but then certain secondary phenomena become more conspicuous, but they do not much disturb the observation. Pain is the most frequent cause of failure in these experiments; with many persons it renders the galvanic irritation of the nervous apparatus of hearing utterly impossible. In some cases I succeeded by introducing an electrode into the auditory passage, and then repeating the experiment after a long-continued application of the ear-electrode upon the tragus, even then it gave rise to great pain, which could only be endured for a short time. Dizziness and stupefaction are impediments which occasionally occur, but only with very sensitive persons, they commonly disappear after a few repetitions of the experiment. A sensation of nausea is sometimes produced by the too long-continued application of more intense currents, but it usually disappears again rapidly. The muscular contractions which sometimes occur upon closing the current, render observations upon the sensation of hearing very difficult; this is especially true of the striking together of the jaws by contractions of the masseters. The contractions of the facial muscles, and the phenomena of flashes of light before the eyes, are apt to withdraw the attention from the perceptions of hearing. They are especially apt to appear if the ear-electrode is applied externally upon the tragus.

Even the contractions of the arm, to which the second electrode is fastened, may act as disturbing elements. All these things deserve to be taken into consideration. There are, besides, some trifling advantages, by means of which the certainty and facility of irritation of the acoustic nerve may be increased; it is thus advantageous to use warm salt water for the filling of the auditory passage, and for moistening the electrodes, instead of common water. In closing the auditory passage with the electrode placed upon the tragus, attention must be paid to keeping the auditory passage always completely filled with liquid; if it is not completely filled, disturbing sounds are apt to occur. The position of the second electrode is certainly of great importance, not for the manner of irritation, of course, but only for the possibility of irritation. As we have to do with a very deep-lying nerve, it follows, from the simplest physical laws, that the second electrode must not be placed too near the ear electrode. It is, therefore, quite a faulty arrangement to place the second electrode upon the mastoid process on the same side.

It would be most conformable to the purpose to place it upon the opposite side of the neck, but this is perilous on account of the violence of the cerebral phenomena which then appear. It seems to be most practical, therefore, to let the electrode be taken in one hand; I have usually fastened it upon the back of the hand on the side opposite to the ear to be examined; the certainty of the experiment is thus increased, without causing too violent phenomena of dizziness, &c.

The galvanic irritation of the nervous apparatus of hearing is, notwithstanding all these precautions, still with many persons an extremely delicate and difficult operation; in many cases repeated sittings and gradual habituation to the disagreeable accompaniments will be required, before the sensations of hearing in the person examined will become clearly perceptible. If, however, this is once obtained, in the following sittings the desired irritation is accomplished easily and surely. A principal requirement for the success of the experiment is calmness and deliberation; we must understand how, by a careful realization of the manipulations to be mentioned, to produce the desired effects without too great annoyance of the person experimented upon; the more slowly we advance the intensity of the current the surer is the attempt to succeed. It is, of course, also of special importance how we question the person experimented upon as to the subjective phenomena. And the minute observations which *Brenner* makes on pages 85 to 87 in his book on this subject, deserve special consideration.

We shall only succeed in any case in effecting the sensation of hearing by closing the chain when the kathode is in the ear.* In cases where the success is imperfect, the longer closure with the kathode will augment the excitability in

* I follow here, quite naturally, Brenner's uncommonly practical directions. Ka = Kathode, An = Anode, S = closing (Schliesung), O = opening (Oefnung), D = duration of current (Stromesdauer), or duration of the closing of the chain. I shall also further designate the formula of the acoustic reaction in the same way. The sensations of hearing are designated according to their character by different letters, Pf = whistling, Kl = ringing, Z = hissing, &c.

such a manner that by following Ka S, sounds appear. We must also, by repeated closure of the kathode, augment the intensity of the currents.

But a far more effectual means is Ka S, after the anode has been permitted to operate for a longer time. The more rapidly the Ka S follows upon the An O, the more certain is the effect; most distinctly, therefore, with the so-called Volt. Alt., when the same are performed as quickly as possible with the current-turner. With a certain intensity of current we succeed in this way in obtaining a distinct sensation of sound at once. If this has once happened, it will usually remain even with a much lower intensity of the current and a simple Ka S. With most healthy persons it is more difficult to obtain a reaction with An O, it appears only with much greater intensity of current than the reaction of Ka S. It is known from experiments upon *Electrotonus* and the law of contraction of the motor nerves, that the excitability of the nerves for An O increases with the intensity of the current and the duration of its closure. Success, therefore, depends upon advancing slowly, in prolonged duration of closure, to the highest bearable intensities of the current, and then suddenly opening the chain. We begin, therefore, An S with a low intensity of current, and increase it more and more during An D, at the quick opening of the chain there is then manifested the beginning of sensation, but frequently only after repeated trials. I am aware that in this I do not advance any thing new, it has been done and better set forth by Brenner, and yet it appears necessary to repeat it again, until we are accustomed to the

experiments so as to conduct them with all the necessary circumspection. The purpose may in this way be obtained with most people. Only with a few healthy persons I did not succeed, even after repeated experiments, and this was on account of their hyper-sensitiveness. A good criterion, whether the necessary intensity of current is reached, is offered by the contractions in the facial region, especially if the electrode has been introduced into the auditory passage.

When they do not appear we may be sure that the intensity of the current is not high enough. They generally appear soon after the electrode has been placed upon the tragus, and are then occasioned by the excitation of the external branches of the nerve. Where the acoustic reaction appeared at all, and distinctly, it was in all healthy persons always and without exception according to Brenner's normal formula, if there was any irregularity of the reaction it was quite unmistakable. In our special case it must be mentioned that the observer himself must have had a considerable amount of practice in the carrying out the necessary manipulations. I have experienced this myself, for although not inexperienced in the technicalities of galvanic researches, I have at present, after several months' practice with this object, acquired a much greater facility and certainty in obtaining acoustic reactions than during the first weeks of my experiments. It is therefore advisable for beginners and unpractised persons to make their first experiments on persons suffering with diseases of the ear, who offer more favorable conditions, and only afterwards to proceed to the examination of healthy persons.

I will give first the results of experiments on persons with perfectly normal ears, or at least with such persons in whom no disease of the nervous apparatus of hearing could be discovered.

I begin with the results which I have obtained on myself, as they offer a very good example of the difficulties which present themselves in the examination of healthy persons.

1. W. E., 28 years old, never suffered from disease of the ear, perfectly normal hearing, ears quite healthy by objective examination. Auditory passage very narrow.

Right Ear.—An electrode of hard gum provided with a little metallic button and a sponge covering, shaped like a common ear-funnel, is introduced into the auditory passage, which is filled with water, the second electrode is fixed upon the back of the right hand.* Experiments many times repeated, and even with from 18 to 24 of Bunsen's elements, were with this arrangement without result. Very violent pain, muscular contractions, dizziness, and nausea appeared, but of sensation of sound I could perceive nothing. I exchanged the water for warm salt water, and applied B to the back of the left hand. By this means I succeeded, on the 16th of October, 1868. The effect of the current was now much more violent; even with from 6 to 10 elements exceedingly acute pain was felt; the Ka produced a very violent stinging pain, with burning, which could even be felt in the fauces, whilst the An produced a violent, but more tolerable pain, which extended inward. With 10 elements the first sensations of sound appeared, with Ka S a distinct and

* I shall, for brevity's sake, mark this manner of experimental arrangement, whereby the ear electrode is introduced into the external auditory canal, in the following experimental records, as "inner experimental arrangement;" I shall call it "external experimental arrangement" when the canal is closed by a somewhat larger electrode (1¼ centimetre in diameter), placed upon the tragus. The second electrode I shall always designate as B.

loud ringing, similar to spontaneous tinitus, of distinctly metallic character, corresponding in pitch to the highest tones of the newer pianos, it became louder and more distinct after repetition of Ka S, and after current-turnings.

The An S and An D gave no distinct sensation of sound; the An D reaction is very difficult to obtain; only with 10 elements and longer duration of closure is a short, weak sensation obtained with An O of the same character as with Ka S. Eight and six elements gave only Ka S reaction. From the foregoing the following formulæ are deduced:—

10 El,	Ka S Kl	8 and 6 El,	Ka S Kl
	— D Kl >		— D —
	— O —		— O —
	An S —		An S —
	— D —		— D —
	— O Kl		— O —

The accompanying phenomena have been very various in these experiments; pain uncommonly violent, at last quite unbearable; feeling of dizziness quite insignificant; facial contortions not very marked; flashes of light always present; sour taste, especially with An D; afterwards sensation of impending syncope. I have, in the experimental arrangement on the external ear, filled the auditory canal with salt water, repeated the experiments many times, and always obtained positive results; only there was then a somewhat higher intensity of current required. With 12 elements first appears Ka S Kl (loud, high-sounding); with from 14 to 16 elements I succeeded first, after a very long duration of closure, in obtaining the An O reaction. The An S and D gives, at this intensity, no certain sensation of sound; while with An D I hear only a weak, soft, continuous rustling, which remains unchanged until the chain is opened; this does not appear upon repeating the experiment

without water in the auditory canal. The accompanying phenomena are somewhat different in this arrangement; the pain is in proportion much less, the facial contortions less, but the contraction of the masseter much stronger, so that they easily distract the attention from the sensations of sound, dizziness, phenomena of light, sensations of taste, varying somewhat according to the poles.

Left Ear.—External arrangement, no water in auditory canal. With 12 elements, there appears first at Ka S Kl (ring, quite similar to the right ear), which continues for some time, and disappears completely with the continued Ka D; Ka O gives no sensation; An S and An D give no trace of sound, not even with 16 elements; after a longer An D with this intensity at An O there appears a very distinct, short sensation of sound, similar, only weaker, as with Ka S.

This experiment, though often repeated, gave constantly the same result. The accompanying phenomena were the same as in the right ear.

2. Anton Rheinstein, 24 years old, merchant, muscular man, under galvanic treatment for a slight degree of impotence. Ear on both sides quite normal, hearing power quite normal, suffers from pain in the bones, never had any thing the matter with his ears.

12*th November*, 1868. *Right Ear.*—There had already, for two days back, been ineffectual attempts made to excite the acoustic nerve with the internal arrangement. Therefore to-day the external arrangement was made use of (B on the left hand, meatus filled with salt water), and a current from 12–18 elements made use of for some time, in varying direction; there were produced the ordinarily observed accompanying phenomena, but no sensation of sound. It was then suddenly changed for the internal arrangement, and immediately with 8 elements Ka S Kl there was perceived a clear, loud, and high whistling, with extremely acute pain. This was also afterwards obtained with 6 El Ka S, and even with 4

Volt. Alt. on the Ka, with great distinctness. But the An O reaction was much harder to obtain. I succeeded, at last, in the following manner: the current was closed with An in the ear, and with 4 El; after An D of one minute, without opening the chain, the force of the current was raised to 6 El; the pain became very violent; in 15 seconds more, 8 El; pain almost unbearable; at the end of a few seconds more, 8 El An O Kl, *i. e.*, a distinct, pretty loud, but short whistling; repetitions of this experiment gave an entirely similar result. The accompanying phenomena, except the pain, were very little changed.

3. Michael Reinhard, 31 years old, agriculturist, under treatment for atrophy of the muscles of the lower extremity, and nearly cured. Both ears quite normal, auditory meatus large; hearing-power and conduction through the bones quite normal; never had any thing the matter with his ears.

Right Ear.—External arrangement, meatus filled with salt water, B on the left hand. The experiment was begun with a protracted closure of the kathode; first, with 16 El, there appeared a distinct, loud, but rather short, high-toned whistling. Following Brenner's terminology, the primary excitability of the acoustic nerve would here be expressed by 16 elements. Diminishing the strength of the current, it appeared with 14 and with 12 El Ka S Kl, but not with 10; the secondary excitability is therefore expressed by 12 El.

I now tried to obtain the An O reaction, but only succeeded with difficulty; the means used for this purpose were prolonged closure, and augmentation of the strength of the current, in the following manner: An D 12 El, $\frac{1}{2}$ min.; 14 El, $\frac{1}{2}$ min.; 16 El, $\frac{1}{2}$ min.; An O, no reaction; An D 14 El, 1 min.; 16 El, $\frac{1}{2}$ min.; 18 El, $\frac{1}{2}$ min.; An O Kl, a short but pretty loud whistling. An S and An D gave no result with any intensity of the current, even with 18 El, and this was particularly noticed, only a trace of sound sensation; even the light rustling occasioned by the fluid in the ear was not in the least

changed by it. With 16 El we succeeded in restoring very completely the normal formulæ, after several current-turnings and the practice of various manipulations, even with 12 and 10 El.

With 8 El sound only appeared with Ka S; with 6 El only a very weak sensation after Volt. Alt. The tertiary excitability is therefore indicated by these numbers.

The accompanying phenomena varied in no remarkable degree; pain moderate, the contortions of the facial muscles followed the well-known laws of contraction of the motor nerve, dizziness moderate, sensation of taste, particularly with An D. Immediately after this experiment, the membrana tympani was of a rosy hue, the handle of the malleus, as well as the walls of the meatus, strongly injected.

Left Ear.—The same experimental arrangement gives exactly the same results. With 16 El Ka S the first sensation of sound made its appearance, similar to that in the right ear, as a high, loud ringing or whistling. With the An O reaction and the ordinary manipulation, a short whistling was obtained with 18 El and still more distinctly with 20; the secondary and tertiary excitability made their appearance in the same way as on the right side. The accompanying phenomena were also similar. An S and An D gave no sensation of sound with any intensity of current.

4. Ludwig Goller, 34 years old, peasant, under galvanic treatment for peripheral paralysis of the muscles of the right arm, hears perfectly well, has never had any disease of the ears.

Right Ear.—Hearing distance normal for speech and the watch conduction through the bones good, meatus healthy, membrana tympani somewhat thickened, and cloudy without light spot. External arrangement, meatus filled with salt water. With 14 El Ka S after An D and An O there immediately appeared a whistling which lasted some time, but disappeared before Ka O. An S and An D gave no reaction. With 16 El we succeeded by the manipulations already described in obtaining with An O Kl a short, weak

whistling, which became louder and more distinct with 18 El. We succeeded, by augmenting the intensity of the current, in completely restoring the normal formula even with 10 El. With 8 El Ka S whistling still ensued, and even with 6 El with Volt. Alt. on the Ka. Accompanying phenomena very slightly developed.

Left Ear.—Hearing distance and bone conduction normal. Meatus normal. Drum head somewhat cloudy, without the light spot. Arrangement of experiment, as in the right. Here also with 14 El Ka S, the first sensation of sound, of the same character as in the right. With 16 and 18 El An O Kl succeeded. Ka O An S, and An D remained in every intensity of the current unanswered by sound sensation. The higher grades also of the nervous excitability may be represented as in the right. Accompanying phenomena quite as slightly developed, and took place in a distinct and regular manner.

5. George Ph. Schmitt, 50 years old, day laborer, under galvanic treatment for progressive muscular atrophy.

Never had any disease of the ears; hearing on both sides quite normal, right drum head somewhat cloudy; left, normal, meatus unchanged.

Right Ear.—Internal experimental arrangement, B on the left hand, 4 El, 6 El Ka S—no reaction.

8 El Ka S Pf, clear whistling, stinging pain, facial contortions.
— D Pf, gradually disappeared.
— O —, no sensation.
An S —, violent pain.
— D —, pain remains.
— O Pf, short and weak whistling, slight facial convulsions.

With 10 El the same formula gave still louder sensations of sound, but the accompanying pain was very severe.

With continuous current-turnings the normal formula was fully restored with 6 and even with 4 El; with 2 El appeared only Ka S Pf, with An O no further reaction.

Left Ear.—With the same arrangement exactly the same results were obtained. With 8 El the first sensation of sound appeared at Ka S, and then also the full formula; the normal formula was clearly perceptible on this side with 6 and 4 El. With 2 El Ka S Kl appeared only with Volt. Alt. but distinctly. Accompanying phenomena, with the exception of pain, moderately developed. With An D some dizziness and sensation of taste; muscular contortions most perceptible with Ka S; weaker with An O and An S. Reddening and injection of the drum head and its neighborhood after each sitting.

6. Franz Brod, 32 years old, plasterer, under treatment for lead palsy, has never had any disease of the ears; hearing perfectly good.

Right Ear.—Hearing distance normal for watch and speech conducting power of bones present. Meatus and membrana tympani perfectly normal. External arrangement, meatus filled with salt water, B on the left hand. After repeated closures in various directions there appeared with 10 El, Volt. Alt. Ka S, a weak, clear sound (whistling), which, with 12 and 14 El, became very strong and loud, and remained for a long time. Ka O, An S, and An D, gave no sensation of hearing. An O Kl is only obtained distinctly after very long duration of closing, with gradually increasing intensity of current from 8 to 16 El, but then appears distinctly with 14 El. Accompanying phenomena, pain, sensation of taste, facial contortions, dizziness, are developed in the usual manner.

7. Mr. M., 40 years old, musical director, under treatment for violin-players' cramp, had in early youth a discharge from the left ear, but says he hears perfectly well, at any rate is not annoyed in his profession by any deficiency of hearing. Patient has diminished hearing distance for the watch (his own watch on the left side 1½

ft., right 3 ft.); for speech no diminution was discoverable. Meatus on both sides quite normal. Membrana tympani on both sides quite clouded with deposits of lime. No rustling had ever existed in the ears.

Right Ear.—External arrangement, salt water in the meatus, B upon the right hand. With 10 El Ka S, high metallic ringing; with 12 El the same becomes much louder, continues pretty long, and only disappears quite gradually. Patient describes it as a ringing metallic sound, somewhat like that from a tuning-fork, and states it to be as high as g or gis in the highest octave of the piano. With 14 El An O, after a longer duration of closing, a similar, but shorter and softer ringing is produced. Ka O, An S, and An D give, with 10, 12, and 14 El, no trace of sensation of hearing. With 8 El the full formula is obtained; with 6 El, Volt. Alt. Ka S Kl is still obtained. Accompanying phenomena very moderate, but present in the ordinary manner. The sensation of pain with Ka, patient describes as stinging; with An, more dull and pressing.

Left Ear.—External arrangement, without water in the meatus; with 10 El, after preceding current-turnings; with Ka S, the first weak ringing, which grows much louder and stronger with 12 and 14 El; here likewise a distinct musical, very high ringing sound, as if proceeding from a fine table-bell, with a very high tone, which keeps on sounding pretty long, but not until Ka O. Ka O, An S, and An D give up to 14 El no trace of sensation of sound. An O with 14 El, after a longer duration of closing, a weak short ringing. Accompanying phenomena moderately developed.

8. George Fuss, 55 years old, farmer, on account of disease seated probably in the centre of the bulbus med. oblong., suffers from uncomplicated hyperæsthesia of the left acoustic nerve. (See farther below; compare also Transactions of Natural Historical Society of Heidelberg, vol. ii., p. 211.) The right ear, on the contrary, is perfectly sound; acuteness of hearing, membrana tympani, bone conduction, and so on, quite normal; gives, with external arrangement,

water in the meatus, B upon the right hand, the normal formula perfectly with 14–16 El, and down to 10 El with Ka S, sensation of sound (a high, fine, ringing whistling) is easily obtained. Ka O and An S always without reaction.

To these results I may add further, that with three other persons I did not succeed in obtaining distinct sensations of hearing. Two of them, to be sure, were made at the beginning of my experiments, and I can not therefore consider them of any consequence. With the third it was impossible to continue the experiment any length of time on account of great pain. From the facts above communicated, from the number of persons operated on, and the number of times the experiments were repeated with uniform results, it follows beyond a doubt that the nervous apparatus of hearing can be excited by the galvanic current, and that it responds to this excitement in a regular manner, with sound sensations. I hope it will not, in view of such regular and positive results, again be denied that the apparatus of hearing may be excited by galvanism. Perhaps some few confirmatory points may be deduced further from the short considerations which follow below of the negative results in others, which may give an explanation, and even show the cause of this want of success. I have gained from my experiments the sure conviction that it is in most cases possible, with some skill and patience on the part of the observer and of the person operated upon, to produce sensations of sound by means of galvanic excitement. Patience, self-denial, and some talent for observation is of course required in the persons experimented upon, in order to arrive

at correct results; it is only after repeated experiments that it becomes easy at once to comprehend correctly the sensations experienced.

What does not succeed, therefore, the first time, must not forthwith be declared impossible. I have already stated that great patience and skill are necessary in the observer to obtain positive results. From what has been said, and from facts positively stated by reliable observers, it can not well be denied that the nervous apparatus of hearing reacts upon the galvanic current in a manner fixed by natural laws. The constancy of the results in repeated cases is so great, that no question can be raised by any occasional irregularity of the reaction. As will be seen my results are in perfect harmony with the facts observed by Brenner on numerous persons. According to my experiments the normal formula is likewise apparent (for a certain intensity of current, which differs somewhat in every individual) in the following manner:—

Ka S Kl,	distinct, accented sound.
Ka D Kl >,	sound disappearing by degrees.
Ka O —,	no sensation of sound.
An S —,	" "
An D —,	" "
An O Kl,	weak and short sound, similar in character to Ka S.

This normal formula is of course only valid for those medium current intensities which are generally applicable to the head. The effect of higher current intensities is of

importance from a medical stand-point, as they are not generally applicable to the head. From the same stand-point it is of little interest to us to know in what manner the galvanic current will operate upon the bared, isolated, and abused nervous apparatus of hearing; we shall never be able to excite it in an isolated manner in the living body. We have first simply to examine in what manner under given anatomical relations the nervous apparatus of hearing reacts upon the galvanic current; in spite of the haughty sneers of certain physiologists who look upon such endeavors with distrust, I believe we now possess in the regularity of the galvanic reaction of the apparatus of hearing a sufficient guaranty, that, under the given anatomical relations, a certain influence of the galvanic current upon this apparatus is possible, and that the influence will always be followed by certain regular phenomena.

We accept this as true, all the more readily as the results of this excitement, as already shown, circumstantially, by Brenner, are in such striking harmony with certain facts which are undisputed in physiology, viz., with Pflüger's law of contraction, and with the doctrine of the polar effects of the galvanic chain.

The facts communicated above teach that under the influence of Ka the nervous apparatus of hearing only responds with a sensation of sound upon the closing of the chain, and remains on the contrary unexcited on the opening of the chain; that under the influence of An on the contrary the closing gives no response, while on the opening of the chain a sensation of sound appears somewhat weaker

and shorter than with Ka S. These facts are in perfect concord with the laws laid down by Pflüger, Von Bezold, and others, for the motor nerves (and likewise for the sensory nerves); upon closing of the galvanic chain the excitement only takes place at Ka, upon the opening on the contrary only at An. The excitement with Ka S appears sooner, and is stronger than with An O.

The same laws have been recently established with cogent reasons also for the contractile substance of striated muscular fibre.* This much at least seems certain from all these researches that the current direction in the nerve or muscle is completely immaterial for the production of either of these polar effects; it is only of some influence on the conducting power of the exciting polar effects in a definite direction (*i. e.*, with other words, upon the appearance of muscular contraction on one side, and sensation on the other), because even on the poles, besides the exciting effect, influences will appear which hinder conduction. In the immediate neighborhood of one of the poles its specific effect will always appear.

If we therefore succeed in bringing a nerve or a particularly excitable part of it (say its terminable fibres) under the influence of one of the poles, its specific effect will always soon appear. The facts above stated teach us that it is possible to bring the nerves of hearing, or at least single parts of it, sufficiently under the influence of one pole, although it may be perfectly impossible to state

*Th. W. Egelmann, Ueber die Reizung der Muskelfaser durch den constanten Strom. Jenaische Zeitschrift für Medicin iv., 295–306.

the direction in which the current passes through the nerve of hearing itself.

The regular appearance of the polar effect in question shows that this effect is in every case the preponderating one. Under the influence of Ka we experience, therefore, a sensation of closure in the ear, under the influence of An only a sensation of opening. It is highly striking that not even with higher current intensities, as it is possible also in the motor nerves to obtain the closing sensation with An, and the opening sensation with Ka. It is difficult to give a satisfactory explanation of this fact. The direction of the current in itself, which is perhaps conditioned upon the position of the nerve in the petrous bone, or the influence of the poles which hinder conduction, can, with a centripetal nerve, and by the only current direction anatomically possible, by no means account for the non-appearance of the phenomena of excitement. It seems to me simplest to accept that only the extreme fibres of the acoustic nerve are able to be excited by the galvanic current, and that they always come exclusively under the influence of the pole nearest to them, whilst the opposite electric appearances are only found in the central section of the nerve which is perhaps not at all, or at least not by such weak currents, capable of excitement. Be this as it may, the fact is sufficient for our purpose, *that by the experimental arrangements which are possible for us, with a healthy person none but this normal formula appears, and that we are permitted to account every aberration therefrom a pathological phenomenon.*

Under pathological conditions, as may be seen by Brenner's and my observations yet to be mentioned, an An S reaction, and even the Ka O reaction are not very rarely obtained ; however, in physiological conditions with quite healthy acoustic nerves, this seems not to be the case. Truly now and then, even with An S a sensation of hearing was perceptible by me, but on a closer examination this appeared always to be a deception. I myself thought repeatedly that I perceived in my ear during the An D a quite weak, scarcely definable, and continuous sensation of hearing, but it disappeared completely, if I made the experiment without filling the ear with water.

Until now I have never succeeded, in spite of special attention directed to this point, with healthy persons in obtaining a distinct sensation of sound, even with proportionately high current-intensities with An S. I must, therefore, for the present, until further researches, consider the above stated normal formula as the correct one. With regard to the kind of sound sensations produced, they seem, according to my present experience, not to be very variable with healthy persons.

As a rule, a high metallic, more or less clear and pure, ringing is experienced, which is designated by most as a kind of whistling. I myself have had a sensation similar to subjective ringing in the ears, others compare the sound to a fine, very high-ringing table-bell. This depends, perhaps, on the fact that the anatomical situation of the nervous apparatus in question constitutes a favorable condition for the efficiency of side-currents.

Only in pathological conditions I have so far heard other sensations of sound described; high tones are regularly said to be much louder and more musical, besides there has been described to me a humming and buzzing as of bees, &c. I have always found the same sound with the same person; in pathological cases the sound with different current-intensities partook sometimes of a different character, it became with higher intensities clearer, with lower more dull. With the same person the first sensation of sound appears with nearly the same intensity of current; it is, of course, not possible to determine this exactly, on account of the different electro-motor power of the battery on different days on account of the changing condition of the electrodes, the skin, moistening liquids, &c. In high degrees of hyperæsthesia of the nervous apparatus of hearing, I have been convinced several times that the removal of An from the ear and carrying towards the chin, has the same effect as anode opening; ringing ensues, which is the louder the more rapidly this removal is accomplished, if one moves the An to the ear again, the ringing disappears; the effect, therefore, is the same as with An S. It is the reverse with Ka. Removing the latter from the ear makes the ringing which existed before disappear, approaching the Ka produces it again, the louder the more rapidly it is done, all exactly as Brenner has already described it. I do not doubt that all the phenomena which have been mentioned may be reduced to a direct excitement of the nervous apparatus of hearing by the galvanic current.

I am, therefore, entirely of Brenner's opinion, that here

the question is of a direct conducting and direct excitement of the nervous apparatus of hearing. I can not comprehend how people can return forever to the improbable hypothesis, that the sensation of hearing produced by the galvanic current depends upon reflex action from the trigeminus.

Leaving out of consideration that the existence of similar sensations, especially in the higher nerves of sense, is not yet at all fully understood by physiologists, it seems to me also that all the facts are against this voluntarily assumed hypothesis, so that I believe we must entirely dissent from it. On the other hand, the idea of the direct excitement is so perfectly congruous with all that we daily observe in the galvanic excitement of the nerves of the body, that I can not see why we should not prefer the simple explanation which agrees with all the facts, to an incomprehensible hypothesis. The reasons given by Brenner against the view of reflex excitement of the optic nerve, as also, upon p. 94 *et seq.* of his book, against reflex excitement of the acoustic nerve, seem to me quite sufficient to refute this view. Most striking seem to me the facts which show that with such a position of the electrodes as is unfavorable for the entrance of side-currents to the deeper parts of the nerve of hearing, while they are entirely favorable to the excitement of the trigeminus, the sensations of hearing decrease or disappear, while with such a position of the electrodes as favors the penetration of side-currents into the depth, the intensity being at the same time diminished, the sensations of hearing become more distinct and louder.

I have made a series of experiments hereto appertaining on a case of hyperæsthesia of the nerve of hearing (see below, Fuchs), and will communicate an abridgment of them here.

1st Series.—It is to be examined, what intensity of current is required in different positions of the second electrode for producing sensation of sound, while the first electrode remains fixed upon one point in the neighborhood of the ear. There always required 10 El, with a small button-shaped sponge electrode conducting the current through the mastoid process as well as through the region in front of the tragus, for the first sensation of sound.

The Ka now remained immovable in front of the tragus; then there is required for the obtaining of Ka S Kl,

With the An on the infra-orb. foramen of the same side,	12 El.
" An on the malar bone (1″ from Ka),	16 El.
" An on the temple,	14 El.
" An on the lower jaw,	14 El.
" An on the mastoid process, same side,	20 El.
" An on the opposite shoulder,	14 El.

Thus with An on the opposite shoulder, sound appears with the same number of elements, as when upon the infra-orbital foramen of the same side; although in the latter case the resistance to conduction is much less, the pain and the excitement of the trigeminus is always greater. The same relations take place with Ka behind the ear; here likewise the greater intensities of current are required, the more favorable the position of the electrodes for a union of side-currents. The same condition obtains also for the An O reaction, if the An is placed near the ear.

2d Series.—It is to be proved, whether, with one and the same intensity of current, sensations of sound appear if electrode B is placed on different points.

In them, the button-shaped sponge ear-electrode is introduced, well moistened, into the meatus not filled with water; the tolerably large electrode B is placed at different points near by, and with 4 El simply Ka S made, with 2 El. Volt. Alt. used upon the Ka.

Left ear.	An on right cheek.	Right malar bone.	Left cheek.	Front of left ear.	Left proc. mastoid.
4 El. Ka S	Loud sound	Somewhat weaker.	Weaker.	Very weak	Nothing.
2 El. Volt. Alt.	Loud sound.	Weaker.	Very weak.	Nothing.	Nothing.

I need not add any thing to these experiments; they certainly speak decidedly for the opinion that it is the deeply entering influence of the current which gives rise to the sensation of hearing, and not the irritation of the trigeminus. It may also be concluded from them, that the sensation of sound is not produced by the directly irritating operation of the galvanic current, but that they as well as the subjective phenomena of roaring in the ear which appear, are the result of a heightened sensibility of the nerve of hearing. Aside from the many times very different quality of this roaring, and the generally high metallic character of the sensation perceived: aside from the fact that an increased sensibility to external sounds is not perceived in any noticeable degree—the normal formula obtained is not in accordance with the law ascertained by Pflüger, and can not be explained by it. The Ka sensation ought to increase in intensity during the Ka D, as the electrotonic excitement increases during the duration of the current (especially with relatively weak currents) the Ka O sensation ought to occur after the disappearance of the Katelectrotonus (after a nega-

tive modification of short duration) a very well defined positive modification of the nerve manifests itself.

It will, therefore, be more simple from these reasons to remain content with the direct excitement, which is in itself so perfectly in accordance with the facts found otherwise and established beyond doubt.

It is of but little satisfaction, after having convinced one's self by one's own trouble and labor of the correctness of scientific facts, to occupy one's self with the negative results of others on the same subject, and to ponder over the causes to which these failures may be attributed. After having satisfactorily convinced myself of the difficulty of galvanically exciting the ear, as well on myself as with numerous others; after having, nevertheless, become convinced that it is possible with some perseverance and skill to succeed even with healthy persons in most cases, I can not refrain from pronouncing my conviction in so far, that those who obtained negative results have either lacked the necessary patience and skill, or they have experimented after quite impracticable methods.

With continued practice and with the application of the manipulation repeatedly described, even those will succeed, if they are in earnest in the matter, in overcoming the continual failure of their experiments.

Schwartze's unfortunate experiments* have been explained by Brenner,† in his criticism in reply, in such a full and convincing manner, that it is superfluous to spend one

* Schwartze Ueber die sog. Electro-otiatrik Brenner's. Arch. f. Ohrenheilk. I.
† Brenner, Erwiderung. Virch. Arch. Band 31. S. 483.

word further on it. I can only recommend the impartial treatise of Brenner to the repeated perusal of all those who intend to occupy themselves in real earnest, and with scientific aim, with this interesting subject; it contains an unusual amount of instructive material. Even on the completely negative paper of Sycyanko,* who likewise denies the possibility of exciting the nervous apparatus of hearing by the galvanic current, I have nothing to add to that which Brenner has already said.† Moreover Bettelheim, of Vienna,‡ did not obtain satisfactory, although not quite negative, results: as no particular descriptions of method, current-intensity, &c., are given, we need not stop to discuss it.

As however Bettelheim, in his Thesis III., can not omit to throw suspicion on the teachings of Brenner, I refer to the work of Brenner above cited (Virch. Arch. B. 31. s. 510), where he explains himself more fully with regard to the reliability of the results obtained on deaf and hard-hearing persons; certainly the normal formula of Brenner has not been deduced from deaf persons and those hard of hearing. The most recent negative results, lastly, come from Schwanda, of Vienna.§ Although he has, in a supplement to his paper published in the *Oester. Jahrb.* (*l. c.*, p. 218), ex-

* Sycyanko, Ueber die Wirkung des Galv. Stroms auf das Gehörorgan. Deutch. Arch. für Klin. Med. B. iii. p. 601.

† Brenner: Z. Geschicte d. Reizg. d. Hörnerven, etc., ibid. Band. iv. S. 436.

‡ Bettelheim: Kurzes Resumé d. Ergbn. electro-otriatr. Studien, Wien. Med. Presse, 1868. No. 23.

§ Schwanda: Ueber die Wirkung der von der Holtz'schen Maschine gelieferten Spannungs Ströme am Menschen. Pogg. Annal. 133, §§ 622–655. Derselbe: Ueber die F. Maschine van Holtz und ihre Verwendung in der Electro-therapie Oester. Med. Jahrb. 24, §§ 168–218.

pressed himself with a certain confidence in opposition to the assertions of Benedict in such a way that the acoustic nerve of healthy individuals could not be excited to subjective sensations of hearing and to sounds, particularly not by the galvanic current, I can not omit declaring that his negative results are only attributable to his entirely faulty experimental arrangements.

From the treatise published in *Pogg. Anal.*, it may be seen that Schwanda places the one wire-shaped electrode in the meatus without filling it with salt water, and the second electrode upon the mastoid process of the same side.

That this is the worst possible arrangement, may, without regard to the simplest physical laws of the distribution of currents in conducting bodies, be inferred from the experimental results above-mentioned.

The intensity of current required to excite the nervous apparatus of hearing in healthy persons, is, with this position of the electrodes, in every case so considerable, that the pain is utterly unbearable, apart from the fact that the unavoidable muscular contraction would render impossible the fixation of the isolated electrode in the meatus. In reading that Schwanda in these experiments has perceived no facial contortion nor dizziness, it becomes perfectly evident that the experiments were made in a very unsatisfactory manner. They therefore prove simply nothing.

In my remarks on the secondary phenomena which occur on the excitement of the ear with the galvanic current, I need not occupy much time. They have been observed by me

exactly in the same manner as is so thoroughly described by Brenner. With one individual this, with another that, group of phenomena predominated, and likewise they varied in the different experiments. As far as I am aware there has not been any objection made to the correctness and exactitude of these more subordinate phenomena referred to by Brenner.

I will now proceed to the communication of some pathologic cases which have come to my notice in the *Ambulatorium* of the medical clinic of this place; they are neither numerous nor exhaustive, as I have made no efforts to obtain such cases, the object is only to show that changes of the normal formula happen with diseased ears, and may be proved with exactness and precision. I have not yet made any careful therapeutic experiments with the ear, but hope to occupy myself with it in the further progress of my experiments, as the results to be anticipated are of the highest theoretic importance for electro-therapeutics.

GALVANIC REACTION OF THE APPARATUS OF HEARING IN PATHOLOGICAL CONDITIONS.

I give here simply the cases so far observed, and shall accompany them with very few remarks.

1. *Simple hyperæsthesia of the left auditory nerve, with humming of the ear of some continuance.*

George Fuchs, 55 years old, day laborer, very intelligent, not hard of hearing, under galvanic treatment for disease probably central of the medulla oblongata. In the course of the treatment I

discovered accidentally the comparative excitability of the left nervous apparatus of hearing by the galvanic current, and was induced to examine the ears more carefully.

Right Ear.—Subjectively and objectively quite healthy, gives with 12–16 El the normal formula with great distinctness (see above, No. 8). The left ear, with which the patient says he has suffered for 4 or 5 years, shows materially different relations.

Left Ear.—Hearing distance for speech and watch somewhat diminished (for watch at a distance of 4 inches). The objective examination which Prof. Moos was so kind as to institute, shows slight hyperæmia over the handle of the malleus, which is pressed inward rather more strongly than normal. The concavity of the drum is increased, particularly in front; in the front and lower quarter, corresponding to the position of the light spot, a space about the size of a lentil depressed below the level of the surrounding membrane, in the neighborhood of which is a small shining spot (atrophy of the drum? cured perforation?). Patient, however, has never suffered from pain of the ear.

The examination with the galvanic current (internal arrangement, salt water in the meatus, B on the right hand) gives the primary excitability with 6 El, and there is deduced from it the following formula:—

6 El Ka S Kl, a high whistling.
— D Kl ∞, whistling, continuing till the opening of the chain.

— O —,	no sensation of sound.	The same formula appeared with unfailing certainty and precision with 8–12 Elem.
An. S —,	ditto.	
— D —,	ditto.	
— O Kl $>$,	sound remaining tolerably long.	

The continuation of the experiment gave the same formula quite unchanged, even with 4 El. With 2 El it was only changed in

this respect, that the Ka D Kl did not continue till the opening of the chain, but disappeared before it. With 1 El, however, even with Volt. Alt., it was no longer possible to obtain any sound sensation. I have repeated the experiment upon this man innumerable times, with various experimental arrangements, and always obtained, without exception, the same result. The rustling in the ear remained, during the several months of continuous treatment, almost completely absent.

2. *Simple hyperæsthesia of the auditory nerve on both sides. Constant noises in the ears; temporarily diminished by* An D.

Wm. Zimmerman, 62 years old, trackman, suffers from slight emphysema of the lungs with moderate dyspnœa; for several years has had some polyuria and a good deal of thirst; urine of a reddish-yellow color, clear, spec. grav. 1,010, contains neither albumen nor sugar. Patient complains, besides, of dizziness and confusion of head, and has a constant strong humming in his head which only seldom desists. He describes this as being like the roaring of a strong wind, not localized in one ear, but in the whole head, particularly noticeable, however, in the occipital region. His hearing is often interfered with by it. He has formerly suffered several times with a discharge from the ears. Intensity of hearing for watch diminished on both sides to 3–4 inches; for speech only slightly diminished. Bone conduction for a small watch present; right rather better than the left. Left drum somewhat cloudy, handle of malleus very prominent, light spot present, meatus normal. On the right side, with the exception of slight dimness of the drum, no abnormality.

23*d November*, 1868.—*Right Ear.*—Internal arrangement, warm salt water in the meatus, B on the left hand. 4 El Ka S —, 6 El Ka S —, An S —, An O —, then immediately 6 El Ka S: loud,

high whistling, which remains until Ka O; now, also, with An O Pf′. With 4, and even 2 El, the following formula is obtained:—

4 El	Ka S Pf′
	Ka D Pf ∞
	— O —
	An S —
	— D —
	— O Pf′ >

Even with two elements the whistling continues as long as Ka S is continued; patient, indeed, often thinks that it has disappeared, but when the chain is opened he says, "Now it is quite gone."

The accompanying phenomena are very slightly developed, pain only with 6 El Ka S, rather severe; during the continuance of the closing of the chain the patient hears (with both poles) an additional noise in the meatus, "like water boiling" (Electrolysis). I now tried to effect some influence on the noise in the head from the right ear.

The An is in the ear; 2 El, the humming continues.

An D — 4 El: humming becomes weaker; after 1 min. almost disappears.
—— 6 El: humming completely gone, after 1 min.
—— 8 El: completely disappeared; after *ca.* 10 sec. again.
—— 6 El: no humming after 20 sec.
—— 4 El: weak humming; after longer duration no humming.
—— 2 El: quite weak humming; after long duration no humming.

The chain was then slowly opened; no humming, head quite free and light.

Now the left ear is taken into the chain, experimental arrangement, mutatis mutandis, the same; 4 El Ka S —, 6 El Ka S —, An S —, An O —, then quickly 6 El Ka S: strong whistling; the

humming in the head returns, but somewhat weaker than before. An S: it becomes weaker; Ka S: it becomes stronger again. The formula of reaction is now first established; precisely the same relations show themselves as in the right side; with 6,—4,—2 El, the exact formula of Brenner for simple hyperæsthesia. The humming continues moderately after this experiment, and is now abolished in the following manner:—

An D 2 El: moderate humming.
—— 4 El: humming disappears after about 1 min.
—— 8 El: humming disappears " " "
—— 4 El: very weak humming which half disappears after 1 min.
—— 2 El: hardly a trace of humming: soon disappears.

After longer An D the chain is cautiously opened; no humming, patient feels uncommonly easy and free in the head. On the 27th November patient came again; after the first sitting the humming in the ears did not recur during the whole day; appeared again next morning; since then it is the same as before.

To-day the same experiment as at first, with external arrangement and with exactly the same results.

To-day also I succeeded, with An D and gradual withdrawing on both ears, in bringing the humming completely to an end. Patient has not returned for observation.

3. *Simple hyperæsthesia of the right auditory nerve. Hyperæsthesia of the auditory nerve, with inversion of the normal formula. Hard hearing in the right, complete deafness in the left ear. Strong humming for many years, especially on the left side. Temporary suspension of the same by* Ka D *to the left ear.*

Miss B—r, about sixty years old, has long been a sickly woman,

has been hard of hearing for many years, had formerly suffered often from discharge from the left ear.

Has had for about ten years continuous humming, which sometimes subsides, has loud rustling and noise in the head, especially on the left side, but sometimes also on the right side. The humming becomes particularly loud and troublesome at night when all is still; by day it is less loudly perceived.

Right Ear.—30*th December*, 1868.—Acuteness of hearing for speech very much diminished, only loud speaking is easily heard. Fine watch only heard by placing it upon the ear; bone conduction for this ear absent, membrana tympani with strong white dimness, in its anterior upper-quarter atrophied spot. Light spot normal, handle of the malleus visible, meatus normal.

External arrangement, without water in the meatus, B on the left hand.

4 El Ka S Pf′, very loud, distinct whistling.
— D Pf ∞, whistling continues till the opening.
— O —.
An S —.
— D —.
— O Pf >, very long-continued whistling.

Entirely the same formula is obtained with infallible certainty, with six and also with two El. With An S and D there is sometimes perceived a weak indefinable rustling, but it is not raised to a distinct sensation of sound even with a higher intensity of current.

It should be stated here that removing An from the ear towards the cheek, produces whistling, while the opposite motion makes it disappear again.

If we approach the Ka, which was before upon the cheek, to the

ear, a loud whistling is produced; by removing it, it disappears again.

Left Ear.—Capacity of hearing with this ear completely extinct, as far as I could ascertain with the means at my command. Speech and watch were not perceived at all; no bone conduction. The membrana tympani is very much depressed, thickened, and with whitish opacity. Handle of malleus not distinctly visible; spot of light present, but smaller than normal. In the hinder upper-quarter a dark, much depressed spot, about the size of a lentil, over which the adjoining part of the tympanum projected in folds (scar of perforation). The valsalvian examination without result.

External arrangement, B on the left hand; the examination shows here at once a complete inversion of the normal formula.

6 El Ka S —,	no sensation of sound.
Ka D —.	
Ka O Pf $>$,	weak, but long-continued whistling.
An S Pf,	very loud whistling.
An D Pf ∞,	continues till the opening of the chain.
An O —,	no sensation.

Accompanying phenomena very moderately developed.

Precisely the same formula may be, with all certainty, given with 8 and 4 El: with 2 El there only appears An S Pf, the reaction with Ka O is here wanting. By quick turning of Ka S with 6 El, I did not succeed to-day in obtaining any sensation of sound, nor did I succeed on the 31st Dec., or the 2d and 5th Jan., 1869. By it the formula given above was repeatedly established for both ears.

Upon the subjective humming the previous, chiefly diagnostic, sitting had no influence worth naming.

On the 9th Jan., 1869, the effect of the current upon the humming in the ears was more carefully examined.

Patient had, in the beginning of the examination, continual loud humming, especially on left side.

The left ear is therefore first taken in the chain.

It first appears that the humming disappears with Ka S and Ka D, all is then silent, as no sensation of sound takes place; with Ka O, humming reappears.

With An S and An D it exists unchanged; besides the whistling produced by it, it has likewise disappeared after An O. Next slipping the electrode into An D was tried, with 2 El and 10 units of resistance on the Rheostat up to 8 El 1100 R; this succeeds without occasioning whistling; the humming goes on unchanged. Now quickly Volt. Alt. upon Ka S; then there arises distinct short whistling, the humming having disappeared. Then the intensity is brought up to 8 El and 1100 R, and then the electrode is slipped out to 2 E and 10 R; lastly the chain opened over the cheek by slow withdrawing of the ear electrode; all this succeeds without causing sensation of sound. The humming has disappeared, the head is quite free and light. Right ear taken within the chain. With Ka S upon this ear, the humming is not produced.

It is also here successive entering into Kn D, from 2 El 10 R up to 10 El 1100 R effected, which succeeds without sensation of sound. Then rapid turning upon An S. An D is retained pretty long and the electrode gradually withdrawn again without sensation of sound. Patient feels afterwards quite free and easy in his head. The humming did not return for several hours, but came back in the night in its former intensity. I will try, in spite of the unfavorable prognosis of the humming in this case, to treat him after the just-described method for a time; time will show with what success.

4. *Hyperæsthesia of both auditory nerves, with qualitative change of the normal formula.*

Franz Arnold, 54 years old, peasant, quite intelligent, and

capable of observation, comes to the clinic on account of dizziness in the head, which has lasted for several weeks; complains at the same time of a humming in the ears, of many years' duration, compared to deep buzzing, especially on the right side. Has formerly had running from the right ear.

With the right ear the watch is not heard at all, nor is there any conduction through the bones; speech of moderate loudness is only perceived quite near. Membrana tympani much dimmed, shows some atrophic spots, but no perforation. Light spot present. Handle of malleus not distinct. Left ear, watch heard at two feet, speech is distinctly perceived; bone conduction present. Tympanum pretty equally clouded; shows weak light spots.

Right Ear (external arrangement without water).—It is at once perceptible that the patient perceives two qualitatively different sensations as shown by the following formula: 8 El Ka S Bz, buzzing, humming pretty loud and strong, materially different from the buzzing which is produced by closing the meatus with the finger, or with water; it is produced likewise if Ka is on the mastoid process.

Ka D Br >, after some time disappearing.
Ka O Si >, a high, fine singing, metallic ringing, pretty long continued.
An S Si, very loud singing of similar quality.
An D Si, ringing continuing till opening.
An O Br >, the singing has disappeared; buzzing appears again; lasts pretty long.

Also, with Ka S, Ka D, and An O a humming; a coarse noise, as the patient calls it; on the contrary with Ka O, An S, and An D, a clear, fine singing, or ringing of metallic character.

The same formula exactly takes place, with infallible certainty, with 10 and 12 El, and then again with 6 and 4 El; with 2 El there only appears Ka S Br and An S Si.

Left Ear (the same arrangement without water).—Here somewhat different phenomena appear. Patient describes here likewise two different sensations which correspond to the different phases of the electric excitement; but these sensations may, by a change of current intensity, be merged one into the other, and brought to take place side by side.

For medium intensities (8 to 12 El) the following formula presents itself:—

10 El	Ka S : Pf,	high, loud singing or whistling.
	Ka D : Pf >,	gradually disappearing sound.
	Ka O : Br,	short humming noise.
	An S : Br,	very loud buzzing or humming.
	An D : Br >,	gradually disappearing sound.
	An O : Pf >,	whistling, as with Ka S, pretty long.

With 14 El a distinct Pf is perceptible at An S, together with Br.

14 El	Ka S : Pf,	very loud whistling.
	— D : Pf >.	
	— O : Br,	humming.
	An S : Br Pf,	humming and whistling at the same time, the latter shorter.
	— D : Br >.	
	— O : Pf >,	whistling.

With lower intensities Pf passes into Br with Ka S: likewise with An O.

6 El	Ka S : Br Pf.
	— D : Br >.
	— O : br.
	An S : Br.
	— D : Br >.
	— O : br.

With 4 elements there only appears Ka S br and An S bz, the first somewhat louder: these sensations may be made much more distinct by Volt. Alt. Patient makes always the same assertions with these relations in different experiments. He states also, that approaching one electrode to the skin of the ear has the same effect as the chain closing, removing of the same, the effect of chain opening. At the second examination, a few days afterwards exactly the same results were obtained.

5. *Qualitative change of formula with absent or only moderate hyperæsthesia.*

August Heller, 31 years old, house servant, had a running of the left ear, 8 years ago, pain, humming, for 14 days, which has happened several times; last time 3 years ago. The right ear he says has never been diseased. Nervous ear-humming never existed.

Right Ear.—(Prof. Moos.)—Low voice perceived at 8 paces, fine watch, 1 foot. Bone conduction preserved.

Deposit of lime on the anterior part of the tympanum; behind it, between handle of malleus and the deposit, an atrophy about the size of a lentil. Handle of malleus much depressed; the rest of the membrane quite cloudy.

Galvanic Examination.—External arrangement without water in the meatus.

12 El Ka S: Br = buzzing or humming as of a large bee, short and weak, but clearly distinguishable from the buzzing produced by simple closure of the meatus.

12 El Ka S: Pf Br >, at first short whistling, followed by longer, louder humming.

14 El Ka S: Pf >, loud and long-continued whistling; with this intensity of current the following formula presents itself:—

14 El Ka S Pf.
— D Pf. >.
— O —, no sensation of sound.
An S Br, very loud buzzing.
— D Br >.
— O Pf >, pretty long-continued whistling.

I did not succeed in changing the buzzing by An S with higher intensities (16 to 18 El) to whistling.

On the contrary, it changes Pf by Ka S, with lower intensity, to Br. With 8 El the above formula appears distinctly. With 6 El there appears with Ka S only Br, likewise with An S. With 4 El Volt. Alt. buzzing likewise arises with Ka S. The same relations entirely appear by repeated examinations with internal arrangement, water in meatus, &c.

Of course the required current intensities were different for producing the several sensations, but the quality of sensations remained always the same.

Left Ear.—(Objective examination by Prof. Moos.)—Perception of speech good; watch heard 1 foot, instead of 6; bone conduction preserved. Experiments with tuning-fork gave no definite result. Handle of malleus so strongly depressed that there could hardly be a doubt of the absence of the posterior part of the tympanum. Just in front of the malleus an oval scar of the tympanum; the remaining part of the membrane was thickened, gray, and only opposite the lower margin of the scar a small, strongly shining spot. With Valsalva's examination the lower half of the scar turns outward and changes in appearance, seems dimmer, while the upper half remains stationary, and the dark, shining look is preserved (adhesion in the cavity of the tympanum?). Galvanic examination (external arrangement without water in meatus). Here appear exactly the same relations; with Ka S, Br first appears, which

changes first to Pf and Br, and then to Pf alone, with higher intensities.

At the same time with Ka S Br appears An S Br, later the Pf with An O. Ka O gives no reaction; Br with An S can not be changed with higher intensities into Pf. With 6 El only Ka S Br and An S Br: 6 El Volt. Alt. Ka S Pf. With 4 El Volt. Alt. on both poles only buzzing. And these results were confirmed with different arrangements and repeated experiments.

Accompanying phenomena on both sides moderately developed; even with lowest intensities of current, facial contortions were present, following the ordinary law of contraction of the motor nerves.

Here I will add briefly the following case:—

6. *Low degree of simple hyperæsthesia* (?) *Former ear-disease.*

Junker, 34 years old, house servant, had a year ago a suppurative inflammation of the cavity of the tympanum, under treatment of Prof. Moos. After paracentesis performed on both sides, and scarifying of the artificial perforations, a simple non-suppurative catarrh of the middle ear with considerable diminution of hearing remained.

The affection appeared at that time during anti-syphilitic treatment, with extreme pain in the ear, and subjective sounds. Prof. Moos makes the following statement: for watch, 30 feet hearing-distance, distinct bone conduction on both sides; likewise for fine watch. Hearing distance for large watch, right side, 18 inches, left 22; for fine watch, both sides, 2 inches. After air injection, on the right side, 20; left, 24. Whispering perceptible on right side at 10; left, 8 paces. Right side hyperæmia of the inner part of meatus and of handle of malleus; this cloudiness of the whole tympanum especially on the periphery. Diminution of spot of light.

Left side meatus not hyperæmic, quite normal, membrana tympani and handle of malleus much depressed, posterior fold of the tympanum very strongly developed.

Galvanic examination (internal arrangement, meatus filled with salt water, B on left hand). On the right ear was found primary excitability.

With 8 elements the normal formula appears; patient hears ringing as if one struck a fine bell.

10 El Ka S Kl,	loud ringing, sting pain, facial contortions.
— D Kl >.	
— O —.	
An S —,	pain pressing; less violent.
— D —.	
— O Kl,	weaker, shorter ringing.

Secondary Excitability.—With 6 El the full formula appears; with 4 El, Ka S, reaction.

Tertiary Excitability.—After several turnings the full formula appears distinctly; with 4 El An O Kl, but very weak. With 2 El Volt. Alt., distinct ringing still appears with Ka S.

Almost exactly the same phenomena appear on the left ear, only that here somewhat higher intensities are required to obtain the several sensations.

The obtainable formula, and also the quality of sound sensations are exactly the same as on the right side.

I have not much to add to the preceding observations. It is clear that they contain a series of confirmations of Brenner's observations, and to any thing further they do not pretend.

I leave the pathological determination of these cases to ear-physicians. I must be satisfied to have shown the exist-

ence of anomalous reaction of the nervous apparatus of hearing upon the galvanic current. In any case they are a new proof that by various diseases of the ear there may be produced finer changes of the apparatus of hearing, as well as anatomical changes, of which finer changes the former science of aural surgery has not even dreamt, and which it could not discover with the means of examination which heretofore existed. It need hardly be mentioned that now, as Brenner has shown in a convincing manner, *the examination of a diseased ear will only be complete when the auditory nerve has also been examined by means of the galvanic current.* After I have succeeded in the course of a few weeks, in observing by mere accident quite a series of pathologically reacting auditory nerves, it will surely not be difficult for aural surgeons to find numerous confirmations, in their ambulatorium, of the assertion made above. I would like to add a few words from the stand-point of electro-therapeutics. It has not been possible until now to examine and establish on the motor and sensitive nerve of living man their reaction on the galvanic current in so precise a manner as on the nervous apparatus of hearing. Much less has it been possible until now in the pathological conditions of those nerves to state with such certainty their reaction with the galvanic current as is the case with the nerve of hearing. Even the, in this respect, most exactly examined cases of traumatic and rheumatic paralysis, can not be compared with the pathological results in the auditory nerve.

The facts communicated above regarding the momentary

abolition of buzzing in the ears, offer such striking examples of the influence of the galvanic current upon the pathological state of the nerves, and are so clear and transparent in their effects as hitherto could not be stated with regard to the motor and sensitive nerves. Especially interesting appears to me the relation in Case 3, where, with inversion of the normal formula, the humming also was silenced, not as usual by An S, but by Ka S. The hope may be indulged that from such and similar observations, by degrees a more minute understanding of the therapeutic effects in certain nervous disease, especially in neuralgic and convulsive diseases may be developed, and that from this more minute understanding better methods of treatment may be discovered than we at present possess. I consider, therefore, the occupation with this most interesting subject as one of great promise, and can not too much recommend to every one who occupies himself with electric therapeutics, the acquisition by studies and experiments for himself the necessary practice and certainty in exciting the ear by the galvanic current, in order to obtain by this means new and fruitful facts for this branch of medicine.

With this I conclude the present communication. Nobody is more convinced than myself that the results are in many respects uncertainties and incomplete results. However little I have contributed I believe nevertheless, that I am able to be fully responsible for the facts here communicated. I know they contain nothing new, but are in all material respects only a confirmation of Brenner's assertions.

As it seems that his treatise is but slowly becoming known, I have hastened to contribute my mite, that in this highly important and interesting matter the truth may be recognized. I hope that this endeavor will be taken into consideration in criticising my paper, and wish others would follow my example, and not shrink from the difficulties of the subject, in order to examine it earnestly and minutely. I live in hope by means of this article to protect in the future the electro-otiatrics, as founded by Brenner, against the hasty and ill-considered criticisms of superficial observers.

HEIDELBERG, *January*, 1869.

INVESTIGATION ON THE RELATION BETWEEN THE HANDLE OF THE MALLEUS AND THE MEMBRANA TYMPANI.

By Prof. MOOS, M. D.*

Translated by T. R. Pooley, M. D., New York.

(See Table VIII., Figures 1 to 4.)

Since the publication of *Gerlach's* † classical research the literature of the histology of the membrana tympani has been interrupted by a long interval. Recently investigations upon this subject have again been made.

As the results of these investigations are partly contradictory, it seemed worth the labor to subject them to a new scrutiny, even should no other result be obtained than solving the contradictions.

We are indebted to *J. Gruber* and *Prussak* for more exact contributions on the present subject.

* The following investigations were made in the institution of my honored colleague, Prof. J. Arnold, to whom my thanks are due for his kind assistance.

† Microscopic Examination on the Human Membrana Tympani, p. 53, &c., in his Microscopical Studies. Erlangen, 1858.

Joseph Gruber* came to the following conclusions: "The short process and the greater part of the handle of the malleus are connected with the membrana tympani by a kind of joint, to which the handle of the malleus is only attached by its anterior and posterior margins, but aside from these attachments is free, while the short process of the malleus is surrounded by a concave articular surface situated in the membrana tympani. The articular cavity thus formed is filled with synovia. The fibres of the *membrana propria* have no attachment to the hammer, but unite with the cartilaginous formation mentioned. The short process has no real cartilaginous covering."

Prussak † asserts that the circular layer of fibres of the membrana tympani is so closely connected with the periosteum, respectively perichondrium of the hammer, that it can not be separated from them.

There can be no real cartilaginous covering of the short, process, as half, and sometimes even two-thirds of the whole length of this short process consist of it. The short process shows in its axis large cells of cartilage, which towards the periphery become smaller and longer, and are transformed into the elongated corpuscles of the connective tissue of the membrana tympani. In the adult character-

* Contribution to the Anatomy of the Membrana Tympani. Wochenblatt der K. K. Gesellschaft der Aerzte, 1867, Nos. 1 & 2; also, Anatomy and Physiological Studies on the Membrana Tympani and Ossicula Auditus. Vienna, 1867.

† The Anatomical Relations between the Membrana Tympani and the Hammer. Medicin. Centralblatt, 1867, No. 15. Also, Anatomy of the Membrana Tympani. Answer to Dr. Joseph Gruber. Wochenblatt der K. K. Gesellschaft der Aerzte, 1867, No. 25; and Archiv für Ohrenheilkunde, vol. iii., p. 254, &c.

istic cells of cartilage exist in the interior of the osseous tissue of the handle of the hammer, the surface of which is covered by a similar more or less thick layer of small cartilaginous cells, equally transformed into corpuscles of connective tissue as the cartilaginous part of the short process. Prussak, and also Kessel,* deny the existence of a joint.

I. *Structure of the Handle, and its Relation to the Tympanic Membrane.*

Method of Examination.—Preparatory to the examination the membrana tympani of children was put, together with the hammer and the annulus cartilagineus, into a diluted solution of chromic acid for several days. Absolute alcohol, containing some hydrochloric acid, proved inappropriate, on account of swelling of the structure of the tympanum by imbibition.

The membrana tympani with the hammer in the adult was treated by Prussak's method; that is, was placed for two hours in a solution of one per cent. of chromic acid, with some drops of hydrochloric acid. (For infantile preparations one hour by this method is sufficient.) The preparation obtained with chromic acid was laid in absolute alcohol for twenty-four hours, and afterwards embedded in wax or paraffine. The following method finally proved the best: the membrana tympani is removed together with the annulus osseus, and cartilaginous, from the dead

* Kessel at the same place, p. 310, in his paper "On some anatomical conditions of the Middle Ear."

body, placed for two hours in a solution of one per cent. of chromic acid, containing besides some hydrochloric acid, then the preparation with the annulus osseus is embedded in wax or paraffine.

Then trials are made to cut the preparation, which each time is replaced into the chromic and hydrochloric acids, until fine sections are easily obtained.

In this manner the structure of the membrana tympani does not suffer at all, since it is sufficiently protected by the mass of paraffine. (The preparation, for instance, from which Fig. 4 is taken was obtained by this method.) Both transverse and longitudinal sections may be made in the easiest way after the described methods.

To obtain very demonstrative specimens, sections are placed for a day in absolute alcohol, stained with carmine after known rules, put in water for a short time, and afterwards again placed in absolute alcohol, after that put on the object-glass and covered with the slide until the alcohol is evaporated. In this way even the finest section assumes a certain degree of rigidity, which prevents the preparation from wrinkling or doubling up, when put into oil of cloves; the preparation is then preserved in either Dammar varnish or Canada balsam.

The sections were executed corresponding both to the longitudinal and transverse diameter of the handle of the malleus. By this method of examination we might expect to obtain conclusive results with regard to the arrangements of the parts and their component structural elements, as well as to the existence or absence of certain lacunæ. I

must expressly mention this, because Gruber (*l. c.* p. 63) asserts that the method of studying these conditions by making sections is insufficient:—

"On account of the minuteness of the parts, appropriate sections are difficult to make, and if connective tissue is accumulated in some portion, a discontinuity could not be demonstrated, although it might be seen in the neighboring portion. In some sections, however, we succeed, also, in demonstrating a discontinuity," &c.

After that he further (*ibidem*) says: "In my opinion, we get the best knowledge on the connection between the membrana tympani and the parts of the hammer, if we dissect cautiously the hammer from the membrana tympani. In this we see best where there are connections which must be detached, and where there are none. If the examination is conducted after this method, which in general is very easy, every one will be convinced that my assertions are true to nature."

The method employed by Gruber to decide the question whether there is a hole between the handle and membrana tympani is not in accordance with the principles generally adhered to by anatomists, *i. e.*, to make investigations only on such objects as have preserved their position as nearly as possible, or at least do not show any change of connection.

The application of the method above described shows the invalidity of the objection of Gruber, that the minuteness of the parts render the obtaining of appropriate sections difficult. On the contrary, the dissection of the handle out of

the membrana tympani, which, self-evidently, can not be performed without stretching the tissues and detaching some of their connections, will prove a very abundant source of possible errors in our judgment on the continuity or discontinuity of the parts. By the method last mentioned by me to obtain cuts through annulus osseus, cartilaginous, membrana tympani, and handle at the same time, stretches or ruptures are utterly impossible, because the parts are examined in the position which they keep during life.

Structure.—If we look under the microscope at a transverse section, obtained in this manner, of the membrana tympani and the handle, from a child 14 days of age, we see (Tab. VIII., Fig. 1), in the centre of the section, a mass of hyaline cartilage, which represents in the fœtus the cartilaginous malleus before its ossification (Koelliker).* The hammer consists for the greater part of singly nucleated round cartilaginous cells, which towards the periphery become gradually smaller, and more oval, with less distinct nuclei, so that in the peripheral layers formations appear which by their elongated and dense accumulation are distinguished at the first glance from the central ones. These spindle-shaped cells situated at the periphery are covered

* The progress of ossification of the handle during the first weeks after birth varies greatly. I saw, at least in transverse sections, taken from a child ten days of age, a considerable part of the manubrium already metamorphosed into bony substance, while a transverse section of the handle, taken from a child fourteen days old, showed bony substance only around a blood-vessel situated in its centre (Tab. VIII., Fig. 1). These differences in the commencement of ossification are perhaps dependent upon general conditions of nutrition.

by the cells of the perichondrium in such a way that an uninterrupted transition of both takes place. In this manner the union of the perichondrium, which itself lies beneath the mucous membrane, is effected, and it would be impossible to determine exactly the places in which the spindle-shaped cells cease and a layer of connective tissue of the perichondrium begins. *Hence it follows that between the perichondrium and cartilaginous tissue of which the handle consists, an intimate union takes place, but never a discontinuity or formation of lacunæ.* If we examine the relation existing between the mucous covering of the substantia propria, and the cutis layer of the membrana tympani, on one side, and the handle of the hammer on the other, we find that the mucous membrane stretches over the handle and is uninterruptedly connected with those parts of the substantia propria lying beneath it and surrounding the handle. Only the circular layer of the substance proper is in connection with the handle, and that in such a way that at the place of attachment of the circular layer to the handle of the malleus, the circular fibrous layer, together with the perichondrium, appear as one fibrous layer, the thickness of which gradually diminishes towards the mucous surface of the handle.

The relation between the perichondrium, respectively periosteum of the hammer, and the substantia propria therefore is as follows :—

The fibres of the perichondrium encircling the hammer like a ring, are continued at both sides into the fibres of the circular layer of the membrana tympani. At the

inner side of the periosteum, respectively perichondrium, we see the mucous covering which in both directions goes over into the mucous membrane of the membrana tympani.

Transverse sections of the membrana tympani in the adult show but immaterial differences from the conditions just described. (See Fig. 2).

Here also two layers of the substance of the handle may be distinguished in transverse sections, one situated in the centre, forming the greater part, consisting of bony substance,* and being traversed by very numerous vascular canals, the other situated at the periphery, being thin and going over without a sharp boundary into the membranous mass (periosteum) encompassing the handle. The union of the periosteum with the substantia propria of the membrana tympani is entirely as above described, *i. e.*, is so intimate that we may unhesitatingly consider the circular fibrous layer to be the periosteum of the handle as Prussak has done. Here too is the union between the mucous membrane, periosteum, and bone so close and uninterrupted that nowhere a discontinuity or lacunæ, but just as little the formation of a joint or synovial membrane takes place.

Good *longitudinal* sections through the handle and membrana tympani of the calf and man have, on exact examina-

* I am far from denying the correctness of Prussak's assertions, that in the adult the centre of the handle is provided with true cartilaginous nucleated cells, but I must say that I did not constantly find them in the adult; even missed them in some transverse sections of an individual 86 years of age. There seems to be some variety in this particular.

tion, shown the same results as the described transverse sections concerning the reciprocal relation of the handle and membrana tympani.

The parts situated at the periphery of the handle do not bear the stamp of ordinary hyaline cartilage ; thence arises the question what kind of cartilaginous tissue there exists ?

Prussak gives, indeed, a correct description of these parts, but does not determine the nature of their tissue. He says, (*l. c.*, p. 268): "Such elementary parts similar to cartilaginous cells are always observed over the whole periphery of the transverse section of the handle, but they are less characteristic.

"The true bony tissue gradually loses its peculiar structure towards the periphery, and its cells are replaced by others apparently resembling cartilaginous cells, the latter at the beginning are angular, oval, and finally become, towards the periphery, elongated. Some of them possess nuclei, others are devoid of them."

Prussak does not assert whether this layer, enclosed between the real bone and the periosteum, consists of true bone, osseous like, or cartilaginous substance.

My opinion is: that we have here neither to deal with cartilaginous nor bony substance, but with a transitory tissue, preceding the formation of bone, equivalent to cartilage.

Virchow,* from whom these expressions are taken, calls it osteoid tissue which takes its origin especially in the

* Morbid Tumors, Vol. i., pp. 463, 472, 530, and 535.

proliferating layers of the periosteum, and is encountered wherever the latter ossifies.*

II.—*Structure of the Short Process, and the relation of the latter to the Membrana Tympani.*

In the new-born, by far the greatest part of the short process consists of hyaline cartilage; with increasing growth a gradual metamorphosis of its centre into bony substance takes place. This, however, never reaches so far as to entitle us to assume, as Gruber does, a real cartilaginous covering of the short process; on the contrary, the layer of cartilage occupies in the adult, as Prussak justly remarks, a greater portion of its diameter than its centre, which is changed into bony substance.

A sharp separation between the short process, and the substance of the handle does not exist; the base of the short process is continued uninterruptedly in the substance of the handle of the hammer (see Tab. VIII., Fig. 3).

The condition of the cartilaginous tissue of the short process is essentially the same as in the cells of cartilage of the handle of the child; they undergo a gradual change, progressing from the centre towards the periphery into small spindle-shaped formations, which have already been described in speaking of the handle of the child, and are continued without interruption into the perichondrium, lying under the mucous membrane, with which, however, it is very intimately connected.

* The layers of the Annulus Cartilagineus, which are situated at the inner surface of the Annulus Tympanicus osseus, show quite the same condition.

Despite all my efforts I never could detect, neither in sections of the tympanum of children, nor in adults, a hollow articular surface filled with synovia, situated within the membrana tympani, and receiving the short process of the hammer.

Unfortunately I was not able to confirm another assertion of Gruber's, made in an appendix (*l. c.*, p. 63), *i. e.*, that he has observed fine epithelial cells on the inner surfaces of the cavities between the membrana tympani and the hammer above the short process.

The preparations from which Figs. 3 and 4 are taken did not, especially by applying a strong magnifying power, permit any doubt with regard to the negative result just mentioned. The absence of a joint, or a joint-like union between the tympanic membrane and the short process, is evident also beyond doubt from Fig. 3, although magnified only sixty times.

Résumé.

I. Between the periphery of the handle, and the tissue of the membrana tympani (substantia propria), both in the child and adult, a layer of tissue is constantly found, forming the intimate connection of both, and best called osteoid (Virchow).

II. The short process and membrana tympani also, are united through the interpolation of a continuous layer of osteoid tissue and perichondrium.

Explanation of the Figures to Plate VIII.

Fig. 1. Transverse section through the inferior third of the handle and membrana tympani of a child fourteen days of age.

a. External layers of the membrana tympani.

b. Mucous stratum prolonged at *c* over the handle of the hammer which is transversely cut. At the handle two layers are recognizable; a large central one and a slender peripheral one.

The former consisting of hyaline cartilage, and showing, at its upper end, the section of a vessel, the thin peripheral layer is composed of smaller spindle-shaped productions, and is continued into the perichondrium under the mucous membrane. Its union with the perichondrium also is dense, and in no place the circumference of the transversely cut handle displays a hole.

Fig. 2. Transverse section near the centre of the membrana tympani, and the handle of a man, æt. 26: *a*, external layers of the membrana tympani; *b*, mucous stratum continued at *c* on the hammer, which is transversely cut. Here also the transversely cut handle presents two layers, a central one composing the greater part of it, consisting of osseous tissue traversed by numerous vessels; and a thin peripheral one continued without a sharp boundary into the membranous mass (periosteum) surrounding the hammer. At the places of union between the handle of the hammer and membrana tympani, the parts of the substantia propria of the membrana tympani and the periosteum of the hammer are blended with each other.

Fig. 3. Transverse section through the handle of a still-born child of nine months; near the insertion of the short process the latter, *d*, is to a great extent cartilaginous, and seen as a triangular mass, the apex of which is directed towards the right in the figure, whilst its base is continued into the substance of the hammer.

The latter is already extensively ossified, traversed by numerous vascular canals, and has a large narrow space in its centre.

At the periphery there is a small zone of cartilaginous tissue, covered externally by layers of connective tissue, connected with the substance of the membrana tympani.

The mucous membrane of the drum surrounds the parts just mentioned, and is everywhere continued into the perichondrium.

The letters *a*, *b*, and *c*, have the same signification as in the previous figures.

Fig. 4. Section through annulus tympanicus osseus (*a*), a. t. cartilagineus (*b*), membrana tympani (*c*), and neck of the hammer (*d*) of a child nine months old and still-born.

Immediately above the short process, *e* corresponds to the outer surface of the membrana tympani, *f* to the inner, *g* and *h* to both the tympanic pouches transversely cut.

TWO FATAL CASES OF EAR DISEASE.

By Prof. MOOS.

Translated by J. H. Pooley, M. D.

Although the fatality of certain suppurative inflammations of the ear has long been known to aural surgeons who have kept pace with the progress of aural medicine, still the consideration of the first principles of medical practice, *i. e.*, to prevent disease, or at least to obviate the dangers of a disease already in progress, should encourage the specialist again and again, to call the attention of physicians to such cases, especially if, as in both those which follow, the manner of approach of the life-endangering disease is rare, or in the first case quite unsuspected.

Case I.—*Apparently Latent Chronic Suppurative Inflammation of the Cavity of the Tympanum with Perforation of the Membrana Tympani. Constant Picking of the Ear, Opening in the Anterior Wall of the Bony Meatus, Parotitis, Pyæmia, Death.*

For the preparation to be described below, as well as the history of the case, I am indebted to the kindness of Dr. Dick, director of the Insane Asylum at Klingenmünster, as well as to the assistant physician, Dr. Löchner.

The preparation is from a woman forty-four years old, whose insanity took the form of nymphomania, with whom, on account of her disagreeable sensual propensities, it was hard to have any thing to do. While in the asylum she had never had any serious bodily ailment, nor had she since her residence there even suffered with running from the ear, or any observable hardness of hearing.

The only thing worthy of attention which had been noticed in her for a long time, was that she often put her hand to the right ear, and picked at it with a knitting-needle.

Nine days before her death an inflammatory swelling in the region of the right cheek was observed, and two days later a discharge of pus from the right ear, which was increased by pressure on the region of the cheek and lower jaw. The parotitis, the matter of which was discharged from the meatus, for which the disease was taken, was treated on ordinary principles; pyæmic phenomena, however, soon appeared, chills, flushes of heat, attacks of asphyxia, &c.; the swelling, which was very painful, spread downward even as far as the clavicle, and the patient died in consequence of absorption of matter, embolic processes in the organs of the chest, and violent fever, without any noticeable brain symptoms.

On the *autopsy* a large quantity of pus and dirty serum was found in the external meatus, which flowed out upon pressure over the region of the inferior maxilla. From the right ear, and the region of the temple, down the corresponding cheek and side of the neck as far as the second rib, and also upon the left side as far as the clavicle, there was a bluish discoloration and swelling of the integuments. The skin over these portions could easily be peeled off with the knife from the subjacent cellular tissue, which was reduced to necrotic shreds, infiltrated with pus and dirty serum. The gangrene extended as far as the sub-maxillary region, and included the cellular sheaths of the somewhat discolored muscles, but had not yet reached the lower parts of the neck. The parotid gland was partially disorganized, its lobules easily separa ble, and embedded in exudation. The jugular vein, the coats of which were unchanged, contained a very little dark fluid blood. Carotid artery normal. Under jaw and its articulation intact. (?) Inner surface of the calvarium, temporal bone, as well as the brain and its membranes intact. In both transverse sinuses dark fluid blood and some recent coagula.

Examination of Petrous Bone (Alcoholic Preparation, Tubes wanting).—The most striking appearance in the external meatus is an oval opening, about two lines long and one and a-half wide, with irregular margins, situated upon the inferior anterior wall at its inner end, quite close to the membrana tympani; the oval space is interrupted at one spot by a deficiency of substance, the membrana tympani is completely destroyed except its thickened margin; the margins of the perforation are smooth; in the upper part the margin of the drum is united by a small false membrane to the head of the stapes, and in consequence somewhat drawn inward; in the niche thus formed is found the head of the malleus deprived of its handle, and united with the carious body of the anvil. After removal of the latter the mobility of the stapes appears somewhat

impeded, but not completely abolished. "The cavity of the tympanum (Klingenmünster Post-Mortem Record) was filled with thick bloody matter."

The horizontal part of the mastoid cells, *antrum mastoideum*, strongly developed, and "filled with a thick grumous cheesy matter," which could still be seen to some extent in the alcoholic preparation. The cells in the perpendicular part of the mastoid process were but slightly developed.* Mucous membrane of the cavity of the tympanum thickened.

REMARKS.

If we take into consideration the changes described in the membrana tympani, the bones of the ear, the cavity of the drum, and the antrum mastoideum, there can be no doubt that the patient, although her physicians had not ob served any running of the ears or hardness of hearing, nevertheless, must have suffered for a long time from a latent suppurative inflammation of the middle ear; for the changes described, the thickened matter, &c., could not be the product of a disease which had commenced only nine days before.

It is, on the contrary, highly probable that the inflammation in the middle ear, although causing but slight discharge, had existed for a considerable time, and given rise to the constant manipulations of the patient in picking her ear, &c., which picking had become fatal to her. It may be surmised that, some time before the acute phenom-

* This condition of the mastoid cells is found pretty frequently in autopsies after long-continued suppurative imflammations of the middle ear, and is produced by chronic inflammation of the lining membrane of the cells of the mastoid process.

ena in the region of the parotid and maxillary articulation appeared, a mechanical injury had been inflicted by this constant picking to the soft and bony parts of the auditory canal, so that the transfer of the inflammation to the parotis took place, in the simplest manner, in consequence of a perforation of the wall of the auditory meatus. In the record of the dissection, it is stated that the lower jaw and its articulation were intact; I have, however, permitted myself to add a point of interrogation. For I consider it more probable in this case that the parotitis spread from the opening described through the maxillary articulation; as also the breaking through of the incisuræ Santorinianæ the result of the parotitis, and not reversely the parotitis as consequent on the extension of an otitis externa through the incisuræ.

CASE II.—*Suppurative Catarrh of the Middle Ear on the Right Side after Measles. Union of the Perforated Drum with the Wall of the Labyrinth. Continuation of the Suppurative Inflammation on the other side of the Union. Formation of Polypi in the Middle Ear. Caries and Necrosis of the Petrous Bone. Death from Abscess in the Cerebellum.*

For the preparation described below, as well as the history of the case, I am indebted to the kindness of Prof. Von Dusch.

Theresa Schæfer, two years old, was attacked with measles five weeks ago. During convalescence had running from the right ear. Since that time the patient is said to have had convulsions three

times. Condition on her reception at the Children's Hospital at Heidelberg, on March 1st. Great emaciation: pale, faded complexion. Exanthematous papules in various places, numerous marks of scratching, probably in consequence of itching. Pulse irregular, now quick, now slow. Objective examination of the organs of the chest negative. Occasional slight cough. Appetite wanting. Stools hard, regular.

There is an offensive purulent discharge from the right ear. After her condition had remained unaltered for several days, with the exception of a slight improvement of the appetite, it was on March 10th as follows:—

The child cries a good deal at night, looks staring, pupils equal, reacting, belly large, doughy during sleep. The right half of the face contracted, right opening of the lids smaller than the left. No stool since yesterday. Running of the ear as before. In the evening, temp. 36.8 C. Morph. gr. $\frac{1}{12}$; iodide of potassium.

21*st.*—Lies in a quiet soporose condition since last evening. Strong contraction of the neck and the right arm. Eyes rotated downward and to the right, occasional convulsions of the right side. Swallowing difficult. Temperature in the morning 36.9.

22*d.*—Sopor continues. The child only notices on being roughly handled. On motion of the face the left half is seen to be incompletely paralyzed. Naso-labial fold effaced. Moves principally the right arm and leg. On attempting to move either the upper or lower extremities, they at once exhibit stretching and stiffness, the child may, therefore, be raised by the legs or head, trunk and limbs remaining stiff. Very strong contractions of the neck, when lying on the side complete opisthotonos; thumb of right hand drawn in. Urine passed involuntarily.

On the 20th.—Two hard stools. Pulse 120–116, irregular and small, hands cool. Respiration deep sighing, face alternately flushed and pale.

On the 21*st.*—Arm, hand, and face on the right side, for a considerable time, said to have been spotted, red, and hot; the left side, on the contrary, pale and cold. Right eye rotated downward and outward, left squints inward. Pupils moderately large, and reacting to right. Jaw firmly closed. Swallows only with great difficulty.

22*d.*—Temperature in the evening 36.6. Night quiet.

23*d.*—Stools and urine involuntary. Cheeks flushed, condition of the face same as yesterday. Left eye squints downward. Pupils react sluggishly, strong contraction of the right arm, thumb drawn in. Left arm powerless, with occasional slight tremor. Legs variably stiff. Belly large and hard. Pulse 156. Somewhat more intelligence. Swallowing a little better. Temperature in the evening 37.2.

24*th.*—Pretty quiet at night, takes more nourishment, is more intelligent, contraction of the neck and limbs less. Strabismus not so marked. Pulse 120–130. Temperature 37.1. No stool. Cries a good deal. Temperature in the evening 36.6. Up to the 30th her condition continued almost unchanged. Since the 30th formation of a fluctuating swelling on the right mastoid process.

On the 3d of April it was opened and discharged thick matter. Since the 9th April there has been again universal rigidity of the trunk and limbs. Paralysis of the face less distinct. Discharge from the wound diminished, running from the ear increased. After the soporose condition had again come on, with occasional board-like stiffness of the trunk and limbs, the reception of nourishment became more difficult, the emaciation extreme, and death ensued on the 22d of April, 1866.

Autopsy.—Body extremely emaciated, vivid discolorations on the surface of the belly and thighs. The inguinal glands hard and swollen. Behind the right ear a small wound covered with a scab. Dura mater distended, no coagulum in the superior longitudinal

sinus. A considerable quantity of clear fluid flows from the ventricles of the brain upon dividing the hypophysis; in various places, especially on the anterior lobes, there were several membranous adhesions. Brain and dura mater adherent to the petrous bone, between the base of which and the internal auditory canal matter welled up from the parts below; the adherent spot corresponds to the anterior margin of the lower surface of the right hemisphere of the cerebellum, which is softened. At this spot the os petrosum forms with the dura mater a part of the walls of an abscess about the size of a hazel nut, filled with creamy matter; the cavity of the abscess extends anteriorly towards the crura cerebelli and pons.

The wall of the abscess is smooth, and of a slate-grey color. In its vicinity the consistence of the brain is considerably diminished. Upon further examination the whole right hemisphere of the cerebellum seemed to be transformed into an abscess about the size of an egg, the walls of which, especially posteriorly, were so thinned, that upon removing it they gave way, and the contents flowed out. Most of the brain substance was here destroyed; in many places there is only a thin layer of brain substance remaining covered with pia mater. The inner surface of this abscess is also partly of a slate grey color, but partly also formed of the softened brain substance. The pus is of a highly offensive odor, and partly of a cheesy consistence. The quantity is about two ounces. No connection was found between the two abscesses. The ventricles were very much dilated, their membrane thickened, the brain substance in their vicinity of good consistence and only slightly macerated. The examination of the petrous bone showed in the external meatus a quantity of liquid matter, its membranous lining thickened; the cutis abraded of its epithelial covering, and reddened. Lower and anterior part of the membrana tympani completely wanting, for there is not even a vestige of the marginal portion visible; the remainder, reddened and thickened, together with the handle of the malleus, is drawn

backward and upward in such a manner that the upper portion of the cavity of the tympanum is almost completely separated from the anterior and lower portion.

The communication which may have formerly existed between the portions mentioned is completely obliterated by two globular growths (polypi of the tympanum) one of which is placed exactly below the arched margin of the tympanum which is drawn inward and upward, the other more anteriorly so that together with the swollen mucous membrane it left only a thin fissure through which one could see with a magnifying glass into the fenestra rotunda.

The mucous membrane of the Eustachian tube is unchanged; upon introducing a probe into it we pass through the remains of the cavity of the tympanum directly into the external meatus. Within the space formed by the union described above, is found the region of the stapes. The anvil is wanting. What space yet remains beyond the new formation is filled up with matter and cellular growths. On the petrous bone were found two communicating openings, about the size of a bean, irregular, with partially roughened margins, the one in the anterior wall of the cells of the mastoid process, the other on the posterior surface of the petrous bone, between its base and the internal meatus, exactly where the wall of one of the abcesses of the cerebellum was situated, and adherent to the bone by new-formed connective tissue. The carious opening in the mastoid process was partially covered by a loose piece of necrotic bone, a remnant of its former wall.

REMARKS.

The suppurative inflammation of the cavity of the tympanum following measles, led to the destruction of the anterior and lower portion of the membrana tympani; con-

trary to the general rule, not even its marginal portion remained; then followed the retraction of the remains of the membrane and its attachment to the promontory; the formation of connective tissue completed, as described, the separation of the anterior and lower part of the tympanic cavity from the posterior and upper one, and the patient was thus inevitably lost by the continuation of the suppurative inflammation in the posterior section of the middle ear. Evidently this unfavorable termination might have been avoided by timely and proper treatment before her reception into the Children's Hospital on March 1st. Under such circumstances the removal of the polypi in a similar case might become a vital indication; an indication to which I have first drawn attention, as far as I know, in my *Klinik der Ohrenkrankheiten*, p. 298.

TWO CASES OF EAR DISEASE IN COURT—DOUBTFUL RESPONSIBILITY.

By Professor MOOS.

Translated by J. H. Pooley, M. D.

As is well known, the condition of the organs of the senses, especially of the eyes and ears, frequently demands the attention of the medical jurist. Generally the question to be determined is, whether an alleged disease of these organs really exists or not. Those cases are much rarer in which yet another question is to be decided, viz., whether a disease of the organs of sense is capable of exerting a disturbing influence upon the intellectual capacity of the sufferer. I have had the opportunity of observing and testifying in two cases of ear disease where this question was raised. Both cases appear to me important enough to be published. From the fact that in such cases it is necessary for the furtherance of the ends of justice to make a medical subject intelligible to laymen, my colleagues will excuse the popular manner of writing. As both cases offer

many analogies, we have, for the sake of brevity, avoided the repetition of many facts common to both.

Case I.—*Trial of J. M. of G. for Perjury. Police Court B., July 9th,* 1867.

On being summoned, J. M. of G. appeared to-day, and the declaration upon oath of J. M. F. of R. was read to him (in which he is charged with giving false testimony under oath). After having been instructed of Sec. 200 of the Penal Code, he states: "For about three years I have not had such good use of my senses as formerly. I have almost lost my hearing and my memory; I have a daughter who has also been insane, and was taken first to Illenau, and is now in Pforzheim; I myself have had attacks of insanity, and have been treated by Dr. King now of R., and during the last attack by Professor Moos, of Heidelberg. During these two years I have been at times quite out of my mind."

Decree of the Grand Ducal Court of Heidelberg:—"This statement to be sent to Professor Moos, with the request that he will certify how far it is correct."

OPINION.

J. M. has consulted me three times for disease of the ear previous to my giving this written opinion, viz., 31st May, 13th June, and 10th July, 1867.

The examination of the patient gave the following result:—J. M., 66 years old, states that he has been quite deaf in the left ear for eight years: the hearing on the right has always been better than on the left, but has been failing for six months, with pain on this side. The acuteness of hearing varies at times, being worst in hot and rainy weather. J. M. states that two years ago he suffered for fifteen months with headache and dizziness, for which he was treated by Dr. K. (This statement was denied at his recent

examination). These complaints have improved during the last nine months, for about a year M. says he has had no sense or memory from one day to another; otherwise he has been healthy. When questioned as to the cause of his sufferings, M. states that in his thirteenth year he had a fall, was unconscious for four weeks, and it was under contemplation to trephine him. But since then he has heard very well. When asked whether he suffers from subjective sensations of hearing, he answers, "Not generally; occasionally, at night, the noise is like the ringing of bells." *Result of examination of organs of hearing.* Both external auditory canals large and dry. Right membrana tympani strongly concave, very much clouded, especially its periphery, spot of light perceptible, vessels of the malleus injected; behind the handle of the malleus there is an oval, cloudy spot, probably caused by the union of the long end of the anvil with the membrana tympani. The left drum presents the same general aspect, except that the general cloudiness, the dimness of the spot of light, and the cloudy margin, are still more marked; but the partial cloudiness behind the malleus, and the injection of the latter are wanting. *Nose and Fauces:* Mucous membrane of the fauces, especially the arch of the palate much reddened. M. suffers from great dryness of the throat, which is improved by gargling, likewise with a sensation of stoppage of the nose, for which he is often obliged to take a pinch of snuff at night. Upon the introduction of the catheter into the Eustachian tube on the right side, and on forcing air into the middle ear, there is produced by the motion of masses of mucus a rattling sound and a lively sensation of the entrance of air; the left side is less pervious to air and there is no rattling sound.

Hearing Distance. Right: loud talking, two paces; watch (of thirty feet hearing distance) only heard in contact with the ear. Left side, only a loud shouting in the ear is heard; watch not at all. It is heard when placed in contact with bones of the he[ad]

sides; the tuning-fork in contact with the bones of the head is also heard, without his being able to state distinctly on what side it is loudest. The application of the catheter at the first as well as the following examinations, and gargling with alum which was prescribed, produced an improvement on the right side of from two to four paces; on the left the improvement was very trifling; the hearing on the left side remaining throughout almost annihilated.

Diagnosis. M. suffers with a double chronic catarrh of the nose, fauces, Eustachian tubes, and tympanic cavities, with considerable deficiency of hearing on the right side, and almost complete deafness on the left; but only occasionally, and then at night, from subjective sensations of hearing. The question then is, shall we believe his assertions? "I have no more sense or memory, not from one day to another;" and can we explain these phenomena from the disease of the ears. We frequently meet, in practice, with ear patients who suffer in a similar way to M., viz., with chronic catarrh of the middle ear, and that, too, in persons still young and full of life, and otherwise by no means nervous, who state without being asked: "Since I have had disease of the ears, I can not think well, my memory is weaker," &c. But these are usually cases in which the patients are troubled with violent subjective noises, or with head symptoms of other kinds, and this continually, but of this phenomenon M. only complains "sometimes and at night." I received, for instance, from a patient with continual violent subjective noises the following statement: "The humming becomes so strong that I can neither think

nor speak clearly." Another patient of mine suffered so violently that she repeatedly made attempts at suicide. In my *Klinik der Ohrenkrankheiten*, p. 187, I take the following statements as to this condition from those which are frequently noted in my histories of cases, "I am not the same in mind as I was, I ca nnot think, I am melancholy, I am often at the point of suicide, &c.," complaints which have been confirmed by other aural surgeons in similar cases, most recently by Dr. Kœppe, of Halle, in a paper on *Disturbances of Hearing and Intelligence* (Allgemeine Zeitschrift für Psychiatrie und psychisch gerichtlishe Medicin, Bd. xxiv, H. 122). Dr. Kœppe has proved that such subjective phenomena of hearing, by the illusions of sense to which they lead, conjoined of course with a special state of the brain, may occasion a real mental disease, and mentions cases in which by treatment of the ear disease the whole psychical disturbance has been removed. From all this it follows that the ear disease under which M. labors may possibly produce insanity, but that in him the subjective, long-continued, troublesome sensations of hearing and the peculiar changes of the brain which specially lead to it are wanting. If, then, we are willing to accept the existence of mental disturbance, &c., in M., we must do it on his own statement.

Have we now any other ground beside his ear disease in the examination of the patient from which we may with justice draw a conclusion as to his defect of mind, weakness of memory, &c.? M. is 66 years old. At this time of life there are developed peculiar processes of involution, as

atrophy of the brain from senile degenerations of the arterial system, apoplexies, softening of the brain, &c., conditions which may disturb the life of the brain and the mental condition of the person in a high degree; but these are always associated with other serious bodily ailments which I need not enumerate. But M. has stated: "I am otherwise healthy;" and, indeed, I have found him to be so at his repeated visits to my office, besides he has behaved himself rationally throughout, and remembers all the particulars of his sufferings.

Lastly, there remains one other fact to be taken into consideration: M. had in his 13th year a fall upon the head, and was then unconscious for four weeks, and came near being trephined. Now we know from the literature on this subject that injuries to the head, or mere concussions of the brain often lead, even after many years, to mental disease. This may occur in such a manner as to produce pathological disturbances in the contents of the cranium, or of the cranium itself, although no demonstrable lesions can be found. Griesinger says in his treatise on Mental Diseases that insanity may appear immediately, or after the lapse of years (even ten). Its development at a period long after the injury is the general rule.

The Vienna alienist Schlager has observed among 500 insane persons (see Zeitschr. Wien. Aerzte, 1857, and Griesinger *l. c.*), 49 in whom the psychical disturbance depended directly upon the consequences of previous concussion of the brain—42 men and 7 women: in 21 cases there had been complete unconsciousness; in 16, only want of memory, con-

fusion, &c.; in 12, only dull headache immediately after the injury; in 19 cases the psychical disease commenced in the course of one year after the injury, but in many other cases much later, in 4 cases after more than ten years. The patients exhibited from the time of the injury a tendency to congestion of the brain, upon drinking even a slight quantity of spirituous liquor, from trouble of mind, &c., and frequently hyperæsthesia of the eye (subjective appearances of light, color, &c.). In 15 cases there appeared a short time before, and during the continuation of the mental disturbance, black scotomata, which had a definite influence on the character of the delirium; 18 times hardness of hearing with frequent ringing and humming in the ears, and three times abnormal subjective sensations of smell, with alteration in the pupils, appeared. Very frequently a change in the disposition, and mental character of the injured were the precursors of real insanity. In 20 cases there was noticed irritability, angry outbursts of the wildest kind, less frequently self-conceit, tendency to dissipation, flightiness, and restlessness; in 14 cases weakness of memory, confusion, and attempts at suicide. Of all these symptoms we find in M. only hardness of hearing and weakness of memory. The first may be sufficiently explained by the aural disease, and the latter can not possibly be caused by injury of the head, especially concussion of the brain, which took place 53 years ago.

I believe no sober physician would venture the assertion that there could be such a case in which a lucid interval of 53 years had existed! As no definite questions had

been proposed to me for answer by the court, I confined myself to the simple statement that my examinations of M. hardly justified the conclusion that he is confused in his senses, weak in memory, or incapable of thinking.

The accused having escaped from justice, and not reappearing for examination, the court postponed his final trial till the time of his apprehension.

CASE II.—*Opinion on the state of health of E. B., of H., accused of Perjury.*

By decree of the Grand Ducal Court of Heidelberg. Dated June 25, 1868. No. 17,969. The following questions were proposed to me for answer:—

1st. Is E. B. hard of hearing and in what degree, and was she so in October of the previous year?

2d. Does hardness of hearing cause, and in what degree, weakness of memory, and has this been the case, and to what extent, with E. B.?

Ad. 1. E. B. has already been treated by me for a long time during the summer of 1867 for a chronic catarrhal inflammation of the middle ear, with continual subjective sensations of hearing. At that time the perception of speech was so much weakened that rapid conversation of any extent, without marked raising of the voice and accentuation of the words, could not be distinctly understood. From August of the previous year I did not see B. any more until she was sent to me by the Grand Ducal Court for examination.

The first examination was made on the 21st of June, 1868. E. B. is 67 years old; she says she has had pain in the ear for two years and a half; the suffering commenced with noises, and deafness gradually increased. The pain in the ear developed itself about the time

when a tile fell upon her head from a considerable height, in consequence of which she was confined to her bed for some days; medical assistance, however, was not called in. Since the beginning of her disease she suffers with pain in the forehead and vertex, and with a troublesome buzzing in the ears, which torments her night and day; she has also sometimes great dizziness; towards evening she is often beside herself; in short, she is unsound in the head. She was treated some time ago by the late Dr. V. for palpitation of the heart. The examination of the heart does not show any disease; the pa pitation was, therefore, probably nervous. The possibility must, however, be kept in mind, notwithstanding the want of definite signs of disease of the heart, of that peculiar fatty degeneration of the arterial system, common in persons of great age, which may easily occasion disturbance of the brain.

In addition she has now some disease of the eyes. She says she has never had catarrh of the nose or fauces, nor any other disease. As at this examination the external meatus on both sides appeared to be nearly filled with pretty hard masses, partly whitish, partly brownish, E. B. was directed to make use of the application of warm water for the purpose of dissolving and removing them, and requested to return for a further examination. The examination of the hearing gave the following results: Right side: short sentences in a loud voice understood at a distance of 4 paces, a watch, of 30 feet hearing-distance, heard only on direct contact with the ear. Left side: a sentence of 10 words spoken moderately loud, only 2 feet, the watch (according to her statement) only indistinctly. A tuning-fork, as well as a watch, placed on the bones of the head

are not perceived, a circumstance which at her age may be considered normal. June 28th the ears were syringed; from both, masses are discharged which consist partly of epidermic scales, partly of cerumen, and partly of fat which had been introduced by the patient for her relief.

The condition of the tympanum is as follows: right side, the whole membrane cloudy, its superficial layer loose, in consequence of which the handle of the malleus, which is slightly reddened, is indistinct, and the whole membrane flattened. Left side, the inner end of the meatus reddened, as is also the whole of the malleus, otherwise the appearances are the same as upon the right side. At an examination which was made a few days later, on the 1st July, it was found, as might have been expected, that the redness and sponginess were consequent upon the syringing, both drums now appeared cloudy, mostly upon their inner side, and especially on their margins, as they generally do in chronic inflammations of the cavity of the drum. Upon the introduction of the catheter and the injection of air into both Eustachian tubes, it passes into the cavity of the drum without causing any rattling noise. B. feels herself somewhat relieved by this manipulation on the left side, but on the right not at all. The hearing distance was afterwards about the same.

Now, from what form of ear disease is E. B. suffering? As the external auditory passages and the Eustachian tubes are free, the faculty of hearing still exists, but it is considerably diminished, and, as indicated by the changes described in the membrana tympani, we must, therefore, locate the seat of deafness in the tympanic cavity. We have here to do with an inflammation of the mucous membrane, especially in its connections with the joints of the auditory

bones on both sides, which has extended further upon the left side than upon the right, a disease by which the mobility of the ossicula is impaired in such a manner that vibrations of sound are only imperfectly conducted and received. But this change has still other effects upon the patient, especially on the left side. As the connections of the joints are pressed more closely together, the terminal end of the ossicula, the stapes, is continually pressed into the vestibule, and as the whole labyrinth is connected with the vestibule, the extremities of the auditory nerves are continually under the influence of pressure; hence the uninterrupted buzzing, just as we can produce subjective sensations of light even in darkness, if we press upon the globe of the eye, and so indirectly on the nerves of vision. Especially important are the phenomena of the effects of pressure upon the sides of the semicircular canals. Every mechanical injury of which, be it produced directly or proceed from the cavity of the tympanum, produces phenomena which we frequently at the bedside consider as nervous. Such are staggering gait, vomiting, and even unconsciousness. It has long been known to aural surgeons that pressure upon the external surface of the membrana tympani by plugs of exfoliated cutis, by means of ear-wax, by foreign bodies, *e. g.*, cotton, produces, in consequence of its influence on the vestibule, phenomena of pressure on the brain, shown by dizziness, staggering, indistinctness of vision, numb feeling on the corresponding side of the head, and occasionally also by moods of melancholy (Toynbee). This leads us to an answer to the 2d question:

Does hardness of hearing occasion weakness of memory, and to what extent, and has this been the case with the accused?

Those nervous phenomena of which we have just spoken are observed by aural surgeons in a much higher degree in diseases similar to that diagnosticated in E. B. And here we must take into consideration not only the pressure upon the brain, with its consequences, but also the fact that the disease has its seat in the cavity of the drum, which is very rich in nerves and stands in such manifold relations with other nerve fibres. Thus many patients state that since the increase of their ear disease they are not in their usual state of mind, that their memory is unreliable, and that mental labor wearies them much sooner than usual. Others again complain more of weakness of mind. Many become irritable, sad, ill-humored, melancholy, disposed to suicide; especially is this the case in those who are subject to violent subjective noises. Some become really diseased in mind, or insane. The layman will not find this so very incomprehensible if he places himself under the constant influence of an annoying external sound. How often we feel low-spirited under such circumstances, and for some time afterwards, even when we have rested, incapable of mental labor. How then must a patient feel who is obliged to be actively engaged under the annoyance of a constant violent noise in the head, so distressing that he can not find words to describe it.

The physician is involuntarily led to refer these phenomena to the disease of the ear, by observing how often such

apparently very serious nervous disturbances disappear after treatment which was directed to the ear disease alone. (Here follow remarks on Kœppe, &c., which, as they have already been given in the preceding case, need not here be repeated.) Remembering in the case of E. B. that she has added to the natural an artificial ear-disease by putting fat into the meatus, and that before the evaporation and drying up of the liquid portions of the grease, its contact with the walls of the auditory passage was more intimate, and the disturbance of functions still more considerable than at the time of the examination, we shall not assert too much, if, taking into consideration her want of education, we draw the following conclusions:—

1st. E. B. is hard of hearing in a high degree, and has been so since October, 1867.

2d. Hardness of hearing may produce weakness of memory; E. B. shows, leaving out of account her great age, weakness of memory, attributable to her ear disease.

3d. This weakness of memory may have existed at the time of the circumstances which involved E. B. in the accusation of perjury, but whether it really existed then I leave to the court to decide.

I remark in addition, that, at the repeated examinations, E. B. has never made the impression of simulating. She gives satisfactory explanations when she is able to do so. For instance, in the examination of the hearing power, with regard to her physical antecedents, the examination was more difficult. As to her general relations in life, from her youth up to the time of examination, she gave information

which showed conclusively that there was no particular weakness of memory in this direction. Lastly, we have yet one more circumstance to take into account, although it is not contained in the questions, if we wish to do justice to E. B. in every respect. E. B. states that the ear disease commenced about the time when a tile fell on her head from a considerable height, in consequence of which she was obliged to stay in bed for some days; medical advice not being called in.

The accident did not occasion any real injury of the head.* If there had been a physical disease caused by this injury, other disturbances would have developed themselves in the course of 2½ years, besides headache and ringing of the ears which, moreover, may very well be referred to the ear disease; states of excitement, hallucinations, disturbances of sensation, &c., which, however, we do not find to be the case. A real psychical disease we can not admit, but we must of course keep in view that we may have to deal with the prodomic state of such disease developing still later, and have to consider the phenomena presented by E. B. as precursors of a mental disease to which the injury gave the predisposition, and of which the ear disease and its reactions on the brain is the exciting cause. This, however, can only be decided by the further progress of the case.

The proceedings before a jury at Mannheim, which had been ordered for October 5th, were countermanded, as

* Even slight injuries of the head may occasion psychical disturbances, and *vice versa*.

E. B. had been taken to the Insane Asylum for mental disease a short time before.*

* In the summer of 1868 I exhibited to my auditors an ear patient who was healthy in every other respect. The disease was a chronic affection of the Eustachian tubes (marked peripheral depression of the otherwise very concave tympanum, &c.), with moderate disturbance of the acuteness of hearing, periodical buzzing of the ears appearing especially during attacks of cold or catarrh, headache, and such an irritable state of mind that he begged his wife to let him be alone, to remove the children, not to tell him any thing unpleasant, as "he was not good for any thing during these attacks." He was otherwise of a quiet character, an industrious workman, and of good repute. A purely local treatment relieved him of his, in a medico-legal point of view, important sufferings.

ON THE MEDICO-LEGAL SIGNIFICANCE OF ATROPHY OF THE TYMPANUM, PRODUCED BY HARDENED CERUMEN.

By Professor MOOS.

Translated by J. H. Pooley, M. D.

The long-continued presence of hardened ear-wax may prove injurious both to the walls of the meatus and the tympanum. *Toynbee* mentions certain preparations in his museum, in which, in consequence of hardened cerumen, the bony meatus was found to be very much enlarged; in other cases the bones had undergone a partial absorption; in one a portion of cerumen was found embedded in the cells of the mastoid process, into which it had made its way through an opening in the posterior wall of the meatus. In another case where the cerumen, by its pressure, had caused an ulcerated opening in the membrana tympani, a portion of it had found its way into the cavity of the tympanum.

Toynbee does not mention atrophy of the tympanum caused in this manner by pressure, the reality of which

can as little be doubted, from the concurrent observations of many others, as its inflammation from the pressure of these hardened masses. To be sure, this atrophy of the tympanum from hardened cerumen occurs but seldom. It occurs somewhat more frequently from long-continued closure of the Eustachian tube in consequence of unilateral pressure on the tympanum, sometimes also, as a spontaneous lesion of nutrition in the course of chronic non-suppurative catarrh of the middle ear. In the following case the diagnosis was of medico-legal importance:—

A man, sixty-eight years of age, had been accused of perjury on the following grounds. About a year before, a neighbor had bargained with him for the sale of a piece of land. The neighbor asserted that he had obtained the consent of the accused to part with the land for a certain sum of money. The defendant denied this, and affirmed on oath that he had not given his consent. Plaintiff afterwards brought witnesses who testified to having heard the defendant give his consent. Now the prosecution for perjury was instituted against the defendant. Defendant made objection, stating that he must insist on his former assertion made under oath. If he really had said yes, then he must have misunderstood the plaintiff, as he (defendant) had been hard of hearing long before the pretended sale, and was so at that time. The court committed the accused to me with the communication of the action, and the request to answer the following questions:—

1. Is defendant really, and in what degree hard of hearing?

2. Is it possible to state whether defendant has been hard of hearing for one year?

Upon examination I found both external auditory canals filled almost to the outer opening with black masses, which felt hard on being touched with the probe. It took almost a whole week to remove them by the use of dissolving remedies, and syringing with warm water. Before their removal his perception of speech extended only to the distance of two or three paces; the watch (of thirty feet hearing-distance) was only heard on pressing it against the ear, and by the bones of the head (corresponding to the age) not at all. After the removal of the hardened masses, his perception of speech was very good on both sides, and the watch was heard at a distance of several feet. The inner end of the meatus, and the circumference of the tympanum on both sides, together with the vessels of the malleus were much injected (effect of pressure and syringing). Behind the handle of the malleus, on the right side, was found a dark spot about the size of a lentil, depressed below the level of the surrounding membrane, at which, as was distinctly perceptible by simultaneously forcing air into the tympanum, the mucous membrane was forced up like a pouch, and at the same time was considerably injected, so that there could be no doubt that all the layers of the membrana tympani, even to the mucous membrane, were attenuated.

I affirmed the accused to be hard of hearing, stating, at the same time, that there could be no doubt it had existed at least a year. I inferred this as well from the hardness

of the mass, which of course was indicative of the duration of the affection, but especially from the atrophy which was discovered.

On this testimony the accused was immediately acquitted.

A SIMPLE EXPEDIENT FOR THE DIAGNOSIS OF ONE-SIDED SIMULATED DEAFNESS.

By Professor MOOS.

Translated by J. H. Pooley, M. D.

If we place a vibrating tuning-fork on the vertex, and close the external meatus on one side with the finger or a plug, as is well known, the tone will be heard more loudly on this side than with the open ear; with strong impressions of sound the tone becomes weaker. *Toynbee* and *Rinne* explain this phenomenon by the increased resonance of the external (closed) meatus; *Lucæ*, by increased pressure within the labyrinth; *Mach*, by the impeded egress from the labyrinth.

Politzer has made a series of experiments on this subject on the meatus of men and dogs, and on an enlarged artificial ear. (Archiv für Ohrenheilkunde, Bd. 1, H. 4.) From these experiments it follows that the increase of tone depends on increased resonance, produced by closure of the meatus, and on impeded egress of sound-waves from the ear. Politzer places the principal stress upon the impeded escape

of the vibrations transmitted through the air of the cavity of the tympanum and the mastoid process, while he ascribes only a subordinate influence to the impeded escape of the vibrations from the labyrinth. The decrease of the tone by tightly closing the meatus is dependent upon the extreme tension of the membrana tympani (Mach, Lucæ, Politzer), and also upon the increase of pressure in the labyrinth.

That the augmentation of the pressure in the labyrinth is not the cause of increase of tone, as Lucæ asserts, is demonstrative, according to Politzer, from the fact that it is not necessary to close the meatus, but only to narrow it, or substitute for it a little tube of paper, in order to effect an augmentation of the tone of the tuning-fork, in which case there is certainly no pressure brought to bear upon the interior.

The fact illustrated in this experiment, that the tone of the tuning-fork placed upon the vertex is heard loudest by the closed ear, forms the basis for the diagnosis of one-sided simulated deafness, a process which every physician, even if he is not a specialist, can make use of, in order to form an opinion as to whether he has a deceiver before him or not.

Let us first speak of the different eventualities which may happen in this examination. Some one asserts, for a certain reason, that he is deaf, or hard of hearing, on the right side, but hears perfectly well on the left.

The right meatus is examined and found free from disease. The left ear, on examination, is found to be perfect in its functions. The cause of deafness or hardness of hear-

ing on the right side can, therefore, to express it generally, only be looked for in disease of the middle or inner ear. In one-sided disease of the middle ear the tone of the tuning-fork, placed on the bones of the head, is heard, as a rule (for reasons mentioned above), on the diseased side only, or on this side the ground-tone, and upon the healthy side an overtone, or, as laymen often express it, they hear upon the diseased side a buzzing, and upon the healthy side a singing (Politzer).* In disease of the labyrinth the tone of the tuning-fork vibrating upon the bones of the head is not generally heard at all on the diseased side. As, however, persons suffering from real disease of the middle ear, sometimes assert that they do not hear the tuning fork at all on that side, we will wave this. Suppose the person to be examined is free from disease of the meatus, has good hearing with the left ear, and pretended deafness of the right ear, does not hear the tuning-fork vibrating on the bones of the head, and that the examination of the diseased ear by the mirror, catheter, &c., gives a negative result. I now close the healthy ear with a plug of charpie, and repeat the trial with the tuning-fork. If he now asserts that he does not hear the tuning-fork at all, not even upon the left (healthy) side, he is a malingerer beyond all doubt, if we have convinced ourselves by the functional examination of

* In order to exclude the overtones, either the staff-shaped tuning-fork of 256 vibrations, or a screw arrangement which is fastened on both ends of the tines of a prismatic tuning-fork, which gives higher tones, is to be used. Both plans originated with Politzer. The latter arrangement has not, as far as I know, as yet been described. I have seen it used by him, and it is the more worthy of recommendation, as the sounding of the tuning-fork continues much longer than is the case also with the simple prismatic tuning-fork.

the ear said to be healthy, that its function is really normal, or nearly so; most laymen think that one can not hear at all with the closed ear, not even from the bones of the head, and cases must frequently have occurred to every ear physician, in which patients with impaired hearing on one side attempt to close the healthy while the vibrating tuning-fork is placed upon the bones of the head, but leave the diseased one open, because they are under the impression that they are more likely to receive impressions of hearing during the examination with the unclosed ear, although it is diseased.

CASE I.—*Long Standing Disease of both Ears. Pretended beginning of Disease on the left side after a Blow on the Ear. Pretended Soundness of the Right Ear.*

F. Sitzler, a joiner's apprentice, fifteen years of age, received, ten weeks before my examination, a blow with the hand from his master in the region of his left ear. S. complains before the magistrate that in consequence of this he has become deaf on the left side, and suffers from a continual noise (in the ear). The legal physicians gave a negative opinion, *i. e.*, they declared that they could discover nothing. S. was now referred to me for examination, without the proposition of any special questions, but for a detailed opinion from a careful consideration of the circumstances.

The anamnesis and the physical examination gave the following result.

Duration of the Disease.—S. constantly affirms that he hears perfectly well now on the right side, and always has done so, but has been deaf on the left side for ten weeks, ever since, and immediately after, he had received three blows on the ear from his master. (According to the statement of the master it was only one.)

When questioned as to any variation in his power of hearing, S. affirms that he always hears equally well with the right ear, but with the left only when the roaring ceases, but after a time the roaring and buzzing begins again, and then his hearing is as bad as ever. *Pain?* Sometimes he has tearing pain beginning in the left ear, mounting up over the temple and forehead, and then his head becomes giddy and confused.

Cause of the Disease?—He alleges the blow upon the ear, immediately upon which the roaring and pain on the left side began. This roaring is as bad as the rumbling of a railway, comes on paroxysmally, lasts about half a day, ceases for an hour, then returns suddenly without any known cause.—*External meatus* on both sides without any noteworthy anomaly; upon firm pressure with the finger, S. says he hears no humming on the right side, but he does on the left (!). Right membrana tympani very cloudy, light spot obscured; strong peripheral marginal dimness, posterior fold of the tympanum very prominent, concavity increased. On the left these appearances were found still more strongly pronounced, vessels of the malleus, however, not injected. Mucous membrane of the nose and fauces reddened; mucous glands on the posterior wall of the fauces enlarged. Upon being asked, S. admits that for a whole year he has snuffled a good deal and been troubled with phlegm. With the nasal douche a great mass of inspissated mucus was removed, and S. admits that he feels very much relieved by this manipulation. Upon the application of the catheter, &c., the right ear appears easily pervious from the appearance of a rattling sound; in the left, on the contrary, the permeability is much diminished on account of great swelling of the Eustachian canal. S. says that this procedure feels better on the right than on the left. Testing the hearing distance, with blindfolded eyes (I consider this important where there is any suspicion of deceit) gave the following result. Right—whispering at seven paces, watch (of

thirty feet hearing-distance) at thirty-two inches, bone conduction present; on the left, according to his statement, loud spoken word heard only at two feet, the watch not at all. After the application of the catheter the examination of the hearing distance gave, with bandaged eyes, right side, watch forty-eight inches resp. ten paces, left five paces, for the watch nil. Upon placing the vibrating tuning-fork upon the bones of the head, S. says he has a humming in the head; upon a repetition of the question whether he hears any thing, S. says he hears a sound on the right side. Upon repeating the examination, the right ear being stuffed with charpie, S. says, and repeats emphatically, that he now hears nothing at all.

I omit here to repeat the testimony at length. Its important contents are as follows:—

S. has not only disease of the left ear but also of the right. This disease depends upon a chronic catarrh, which, if the statements of S. on the examination are to be trusted, has led to more considerable ill consequences on the left side than the right, as we frequently observe.

The result of the examination with the finger in the external meatus, and particularly with the tuning-fork, leaves no doubt in my mind that S. misrepresents the truth in the matter. Certain it is that S. has had disease of the ear before receiving the blow; how much this may have added to his previous disease is hard to say; for all S.'s troubles may be referred to the catarrh of the middle ear, even the pauses presented by the roaring in the ear may be explained by varying intumescence of the mucous membrane of the Eustachian tube. At the utmost we can only attribute to the blow on the ear the increase of an already existing dis-

ease. The military surgeon, Dr. *Chimani*, teacher of aural surgery at the Josephinum, in Vienna, makes use of the expedient here described, with very satisfactory results, in cases of malingering of soldiers (military simulation).—(Personally communicated.)

PECULIAR DISTURBANCES OF HEARING AFTER CEREBRO-SPINAL MENINGITIS. CONSIDERABLE IMPROVEMENT BY THE GALVANIC CURRENT.

By Prof. MOOS.

Translated by H. Knapp.

The case I am going to relate is of so manifold an interest that it is well worth a more detailed communication. The peculiar kind of disturbances of hearing is remarkable in a physiological point of view, and therapeutical success in the group of nervous affections of the ear is yet very rare, especially in auditory disturbances after cerebro-spinal meningitis.

John Herzog, æt. twenty-one, a robust farmer from Fuessenheim, near Lahar, felt quite well until Jan. 3, 1866, on which day he began thrashing in the morning at four o'clock. At seven and a half A. M. he had a chill, staggering gait, and drowsiness. Several hours later he felt better again, so that he resumed his occupation of thrashing. To combat the feeling of supposed weakness, he drank a small bottle of wine, which was followed by vomiting, severe headache, and great thirst. On the next morning his relatives observed his eyes to be staring, his limbs stiff, and his hearing hard. A physician ordered leeches and ice. Towards the evening his conscious-

ness returned, his hardness of hearing somewhat improved, but increased to complete deafness on the third day* of the disease.

The vomiting, constipation, stiffness of limbs, alternating with convulsions, squinting and unconsciousness ceased only on the ninth day. Four days later, he could hear the ticking of the clock, and eight weeks later the chimes of the church bells. In the beginning of his convalescence he understood ordinary conversation only by observing the movements of the lips. After a month he was able to understand words, when spoken directly into his left ear. Gradually his hearing improved of itself, to the capability of understanding conversation at from one to two feet distance. For about a year he could not notice any further spontaneous improvement.

The right ear was completely deaf from the time of the disease, until the examination. Several physicians treated his aural affection by the application of leeches, blisters, cups to the neck, instillations of different substances into the auditory canal; finally Dr. Schmidt, at Lahr, employed the catheter, inflation of air, water, vapors, &c., into the middle ear, but without any result, as he kindly communicated to me. Since the return of consciousness the patient suffers from severe tinnitus in both ears, which, on the right side, are continuous, extremely loud, and similar to the noise of a boiler; on the left, however, it abated with the gradual improvement of hearing, but is still present, resembling an uninterrupted ringing, and is allayed only very seldom.

Headache and vertigo, formerly very severe, are now, likewise, inconsiderable. On the other hand, the patient suffers from unsteadiness in walking, which is especially marked in the night, but sometimes, also, in the day. In the morning, immediately after rising, the giddiness is greatest.

* In the cases terminating favorably, reported by Ziemssen & Hess (Deutsches Arch. für Klin. Med., 1, 1, 3, 4, 1865), the hardness of hearing began mostly on the third day.

He thinks that he hears nothing at all with the right ear (which fact is confirmed by the subsequent examination), but only with the left, with which he hears very distinctly both his own steps and the lowest noises.

He asserts that he is able to hear the sound of a railway train in motion a long time before it can be seen. He says that he has heard the noise more than fifteen minutes before the arrival of the train. Moreover, the creaking of the pen with which I wrote down the history of his disease is quite distinctly heard.

He hears a watch, of thirty feet hearing-distance, at twenty feet, and another of six feet hearing-distance at three feet. He hears it, likewise, from the temples and the forehead, and a tuning-fork from the bones of the skull; but all this only on the left side.

By applying the double otoscope* of Mach, I could distinctly hear, myself, on both sides, the sound of an oscillating tuning-fork, which was put on the patient's forehead.

He could understand, however, only at two feet distant, my rather sonorous voice in a very small room.

From the third story of a house he could hear the steps of people passing over the street. On the left side he was deaf for the deeper sounds of the musical scale, a fact which was also confirmed by Prof. Helmholtz, who had the kindness to examine the patient (on the 10th Nov., 1867). Patient could not hear the twelve deepest tones of a piano with seven octaves (including the *mi* of the great octave). On the right side he was, as already said, completely deaf.

The right membrana tympani was very concave, dark, the bright spot reduced; the margin opaque; the vessels of the handle injected.

* I can not too highly recommend this simple instrument for the purpose of a differential diagnosis between affections of the labyrinth and the drum. By this means I heard quite distinctly the sound of a tuning-fork which was placed on the forehead of a patient completely deaf in both ears from an injury for eighteen years.

Valsalva's experiment succeeds on both sides, but is only felt on the left. No râles can be heard on auscultation of the middle ear during inflation, but the noise from the impulse of air on both tympanic membranes is very distinctly heard. This operation, however, had no influence whatever on the degree of auditory acuteness.

I now proceeded to examine the patient by the constant current.

I must mention that this was one of the earliest cases in which I applied the constant current, my arrangements at that time being very imperfect for electro-otiatric purposes.

My having yet little skill in its application on ear patients may, perhaps, be the principal reason for my not obtaining so definite a result with regard to the diagnosis of the case, as might have been expected from the history of the disease.

I am the more confirmed in this opinion by the fact that I obtained, as the following communication will show, different results, when several months later I treated the patient in a systematic manner with more skill and experience, but, also, with improved apparatus (Siemens-Halske's Modified Elements, after Brenner's design). The results arrived at in the first sitting (July 13, 1860) are the following: On the right side I did not succeed in obtaining a reaction of the kathode by applying from 1–15 Meidinger's elements, neither at the closing nor during the action of the current.

I did not venture to use more elements;* on the other hand the noise became weaker at the anode enclosing a chain of only eight elements, but did not diminish further, the number of elements was raised to fifteen, so that I diminished it gradually.

The result was, that during the action of the anode, the noise became weaker on the right side, but was more strongly felt on the

* The pain was too great. One electrode was in the external auditory canal in the hand of the same side; the external meatus was filled with water, &c. Internal arrangement of the experiment according to Erb.

left. After the opening of the anode the noise became louder again on the right side, and remained on the left as before.

The functions of the right ear were neither changed nor improved in any way.

On the left side I did not succeed either,* in obtaining a reaction of the kathode, but during the action of the anode up to four elements, the noise diminished so much that the patient said it had not been so feeble for some time; at the anode, however, the former condition returned.

On examination of the functions the voice now was distinctly understood at six paces, and a watch heard at six feet; before the application, two paces, three feet respectively.

I now encouraged the patient to submit to a methodical treatment. He, however, wished to do this after the harvest. On the 4th of Nov., 1867, I saw him again for the first time. The improvement on the left side, after the first application of the current, and the unfortunate condition of the right side, had remained stationary. On the right side I now obtained with eighteen Siemens-Halske's elements, and 250 resistances of conduction on the rheostat forming a secondary closing, a very distinct reaction of the kathode like a loud hissing, which also persisted during the action of the kathode; but I succeeded in no manner in gaining a considerable *persistent* influence on the subjective noises of this side, nor was the function materially improved; *temporarily* the anode produced a diminution of the subjective noises.

On the left side the character of the noise was changed with 11 elements and 160 resistances of conduction. He hears, apart from his ringing, a loud hissing, which continues during the action of the kathode; on changing to the anode both noises disappear, and gradually interrupting the chain, the noise remains absent for several minutes after the opening of the anode, and then returns. Sudden

* Here, also, the pain was very great.

opening of the anode was followed by immediate return of the usual subjective noises on both sides. We had, therefore, to deal with a case of hyperæsthesia of the acoustic nerve after Brenner.

I now treated, until the 28th of November, especially the left ear by gradual closing of the anode, until the noise disappeared, after which I gradually interrupted the chain by means of a stopper-rheostat, forming a secondary closing.*

The following observation is remarkable in this experiment. The patient constantly asserted that the noise (during the entering the anode), receded gradually from the ear into the occiput, where it slowly disappeared. He even indicated with his finger† the direction of the receding noise, tracing it from the ear to the occiput.‡ During this the subjective noise on the right side became constantly louder, or, as the patient expressed himself, "the noise was thrown entirely on the right side."

After four sittings the hearing power for speech was raised to 15 paces. Examination in two spacious adjoining rooms. After 22 sittings it only amounted to 18 paces, and the subjective noises on this side were much diminished, and showed greater remissions; other head symptoms were no longer present, and the unsteadiness was much less, so that the patient ceased treatment on the 26th of November, content with the result obtained; which, on the whole, may be called unsatisfactory, but rather favorable in consideration of the condition at the beginning of the treatment.

* Dr. Brenner, during his visit to Heidelberg, in the summer of 1867, was so kind as to make me acquainted with the application of this instrument by his method, for which I tender him my thanks.

† For quite a similar observation, see Brenner's Electro-Therapeutics.

‡ I have made the same observation in another case of deafness after Meningitis, in which I succeeded by means of the constant current in allaying the subjective troubles of the patient, but in no way to improve the function, the patient has remained totally deaf on both sides.

REMARKS.

No unprejudiced observer will doubt that the disease just described was a case of cerebro-spinal meningitis; the early symptoms and the acute course of the disease, especially the unconsciousness which suddenly set in and lasted for some length of time. Moreover, the rigidity of the limbs, convulsions, the condition of the eyeballs, the vomiting, &c., in a previously healthy and robust man of 21 years of age, who, after the disease, complained of no other symptoms but deafness, subjective noises, and vacillating gait, sufficiently confirm the diagnosis. Since the same disease, according to the testimony of his family physician, was very frequent in that neighborhood, the case was one of epidemic cerebro-spinal meningitis.

To do justice to my own researches, I must express my firm conviction that the deafness in this case was the consequence of a meningitis.

Voltolini indeed doubts (Monastschrift für Ohrenheilkunde, Year 1, No. 1; Year 2, No. 9) that the form of deafness which I have described as resulting from meningitis (Klinik der Ohrenkrankheiten, p. 322, &c.), is really dependent upon meningitic processes. He considers such cases to be acute idiopathic inflammations of the membranous labyrinth. In the next number of these "Archives" I shall make some remarks on Voltolini's reasoning, and his diagnosis of such forms of deafness.

The annihilation of hearing was rapid and complete; the function only returned slowly on the left side, first with the

perception of tones and noises (after four weeks), whilst the understanding of speech, even in the vicinity, returned only after double that time. If we appreciate the results of the tuning-fork, obtained with and without the double otoscope of Mach, in conjunction with other functional examinations, the integrity of the mechanism of the auditory apparatus becomes evident. The changes described in the membrana tympani have no considerable diagnostic value (the less so, as many remedies had been a long time employed in the outer and inner ear); had these changes really been evidences of an affection of the tympanic cavity, the high degree of the disturbance of function would have rendered it impossible for me to hear distinctly on both sides, by means of the double otoscope, the sound of the tuning-fork placed on the patient's skull.

It must, therefore, have been a nervous affection of the auditory apparatus.

I abstain from expressing my opinion which special region of the ear was the seat of the disease, since it will always be a supposition only whether the nerve was affected at its origin, in its course, or its termination; but this much we may assume with certainty, that a heterogeneous affection took place in nervous regions of different physiological action, because before the treatment a nearly opposite degree of hearing-acuteness existed with regard to the perception of noises and the understanding of speech. The deafness for deep sounds is less remarkable since it is often met with in cases of ear disease in general.

Far more interesting, and practically much more import-

ant, is the therapeutic effect of the galvanic current. After all therapeutic agents which have been recommended in aural surgery up to this day had failed, and the disturbance of function remained unchanged for one year and a half, one application of a rather imperfect apparatus to the auditory nerve for diagnostic purposes produced a considerable improvement of hearing, which by further treatment still increased.

ON RETINITIS LEUCÆMICA (LIEBREICH).

By Dr. OTTO BECKER, Professor in Heidelberg.

Translated by J. H. and T. R. Pooley, M. D., of New York.

In the year 1861 *Liebreich* described a condition of the retina discoverable by the Ophthalmoscope (Deutsche Klinik, No. 50), which he considered as the evidence of an inflammation of this membrane caused by leucæmia, and therefore gave it the name of Retinitis Leucæmica.

He had at that time observed three such cases. In 1863 he gave a representation of the previously described condition in Pl. X. of his Atlas, and says in the accompanying text that he has since then seen three other cases, making six in all. Both communications seem to have excited very little attention on the part of his colleagues or of pathologists. I conclude from this that some of them completely ignore these statements, although they have since then appeared in a new edition of his manual, others only refer to them with more or less reserve, while the otherwise so rich literature of recent years does not contain a single confirma-

tory observation. This appears the more strange to me, as I had myself, in 1866, the opportunity to observe two such cases in quick succession.

In the one case I had the right eye drawn at two different times by Dr. Heitzman, and I exhibited the drawings to the Ophthalmological Congress at Heidelberg in 1868, for the purpose of bringing this interesting subject into discussion. I regret that only Prof. Knapp was inclined to express his opinion, and he stated that he even, during the last summer, had had the opportunity of examining two exquisite cases of retinitis leucæmica, without finding either functional or ophthalmological abnormities of a remarkable character (see Sitzungsbericht der Ophthalmologischen Gesellschaft, 1868, p. 355). This indifferent demeanor of the members prompted me to recur to this subject anew and with greater minuteness.

The willingness with which the publishers and editors of this journal have undertaken to reproduce a number of ophthalmological pictures, in chromo-lithograph, is the reason why I have preferred this journal for my publication.* Of the two cases referred to, and observed by me, one was in the clinic of Prof. Arlt, of Vienna, in the winter of 1866–7, while the other came under my observation in the clinic of Prof. Oppolzer. The latter, P. W., a woman about thirty years old, had formerly been treated for chlorosis (anæmia), and later had been received into the clinic for a considerable enlargement of the spleen, and enormous multiplication of

* The author had to solve a previous engagement, already announced, with another periodical.—Ed.

the white corpuscles. Particular data concerning the history of the disease, wanting. I was led to examine her eyes, only because I had found, in the case soon to be described, changes in the retina, which Liebreich has called retinitis leucæmica. The patient had never complained of impairment of vision, nor was any found on examination. The fundus of the eye had nevertheless a very striking, quite peculiar orange-yellow color, which was very conspicuous even with the common gaslight used in the clinic ; but more especially when examined with daylight entering through an opening in a shutter into a dark room. As in general for all differences of color in the fundus of the eye, the examination with dispersed daylight was of the greater advantage in this case.

Whilst by using daylight the color of the normal fundus loses completely the mixture of yellow, which it receives from the flame of oil or gas, so that it approaches to a pure red ; in cases of leucæmic retinitis the orange remains, and only comes out more distinctly. In our representation, taken from the other case, this peculiar coloring is not exhibited strongly enough, because the original was printed by gaslight instead of daylight.

Equally characteristic were the shades of color of the arteries and veins, as it is generally in the fundus of the eyes colored by the blood circulating in the vessels of the choroid. The veins besides being uncommonly large and tortuous, and of indistinct contour, showed a bluish red approaching to rose, strikingly different from the dark-brown, nearly black-red tint which large tortuous veins

exhibit, for instance, in disease of the optic nerve, glaucoma, &c.

The arteries, on the contrary, proportionately narrow and pale-yellow, with scarcely any admixture of red. There was still another important change in the appearance of the retina besides these changes of color to which I refer more at large below.

The veins most changed were bordered on both sides by a small whitish margin which gave them a peculiar ribbon-like appearance. I had only a few opportunities of examining the patient, and can not, therefore, give any description of the course of the disease.

The first case which was treated for some weeks at the clinic of Prof. Arlt, I was enabled to examine more closely, for reasons to be stated below. I may be justified in describing this case with more minuteness.

John Meldschock, thirty-two years old, officer of the Royal Hungarian Council, from Waag-Neustadt, was received November 26th, 1866, at the eye clinic. In his eighteenth year, fourteen years ago, he suffered for a long time with intermittent fever. Since then it is supposed that his spleen and liver have been enlarged.

In the year 1860, he says he had a chancre at Commorn for the first time; in 1861, he suffered a second infection at Trentschin; since then he has twice had primary ulcers on the genitals. Nor were the secondary symptoms absent. Nevertheless he considered himself healthy till December. 1864. Since that time he complains of great general weakness, which appears at times and disappears, he has also

stitches in the left side, at the same time offensive ulcers on the right calf and fundament.

In January, 1865, there appeared suddenly severe pain in the chest; his physician treated him for pleuritis. After a fortnight he was able to leave his bed, but since then he has not felt well, and through the whole summer so weak that he could hardly walk. First the left leg swelled, then the right, likewise the wrist, elbow, and knee. But the separate attacks only lasted for a short time. In September he was attacked with an inflammation of the throat, and had a swelling in the fauces which did not break. One month later the right eye became diseased, but was restored by the treatment of his physician, who treated his disease as a catarrh. In November, 1865, the left eye inflamed and was very painful. Dr. Rydel was called and diagnosticated iritis, which he, on account of the numerous symptoms of secondary infection, regarded as syphilitic.

For this reason inunctions were instituted; twenty-four inunctions of ʒss each; after the twelfth inunction (on account of commencing salivation) he took iodide of potassium internally.

From the beginning of September he took daily one scruple of iodide of potassium; the iritis disappeared, and the patient felt comparatively well, and he was discharged Jan. 20th, 1866. At the end of February he became sick again, the symptoms were night-sweats, dizziness, vomiting, diarrhœa. Therapy: tannin, good nourishment, iodide of potassium.

A few days later there appeared facial paralysis on the

left side. Dr. Benedict declared the paralysis to be peripheral (?), and would not use electricity, but ordered iodide of potassium. The paralysis disappeared slowly in the course of months. During the whole time he had, towards evening, pains in his hands and arms, and at night violent headache.

At the beginning of June he was sent to Hall, where, after the fifth bath, pains of the bones appeared anew, without swelling however. Inunction was now tried again; after three inunctions salivation appeared, so that after the sixth inunction iodine baths and iodide of potassium were used again.

After the second inunction iritis reappeared in the left eye, but disappeared again after the use of atropine. The patient, on the whole, felt better after his return from Hall, he only suffered from a continual diarrhœa. About the middle of September he returned to his bureau, but was obliged to leave off duty, as the weakness increased so much that he could only walk a few steps with effort and could hardly write.

From time to time there came on, without special cause, attacks of violent vomiting or diarrhœa. His physician discontinued all medicine and tried to nourish him well.

Thus his condition remained, now better, now worse, till the 20th Nov., when he suddenly noticed in the evening that there was a thick veil or film before the left eye. This occasioned him to apply to the eye clinic; at his reception I found M. an emaciated, cachectic-looking man, with a dirty, yellow complexion. The integument was remarka-

bly dry, with numerous fine scales; the hair was scanty, dry; gait slow; respiration difficult. Examination of the organs of the chest showed tubercle at the apex of each lung (of old date ?), enlargement of the heart, with deviation to the right; the second respiratory sound strongly accented, no râles.

Liver and spleen considerably enlarged, on the right side dullness as far as the eighth rib, and some finger-breadths below the cartilages of the rib.

The liver dullness passed over uninterruptedly to the dullness of the spleen. The resistance of the liver considerably augmented, no knotty protuberances perceptible. The left hypochondrium considerably puffed up. A marked resistance was felt by the hand, from the crest of the ileum, as far as the nipple; the percussion from the fifth rib to the crest of the ileum showed complete dullness, which extended in the hypochondrium backwards to the spine, in front to the linea alba. On the gluteal region varices, scars on the prepuce and on the glans; the feet and legs edematous, on the tibiæ no nodes, but numerous highly-colored pigment spots on the skin of the lower extremities.

The urine contains much albumen, no casts, but pus cells and bladder epithelium. The blood was repeatedly examined by Prof. Stricker, and presented quite an extraordinary appearance. Upon microscopical examination the blood appeared pale-red, and resembled bloody matter rather than human blood.

The color was apparently caused by a multiplication of

the white corpuscles, which were easily recognizable by the microscope. Prof. Stricker writes to me, the number of colorless bodies I do not like to mention, it is not to the purpose. There are among them some so large that one of them might easily contain fifty or more red ones. I estimated, therefore, rather the bulk. It is certainly no exaggeration when I state that the bulk of the colorless surpasses that of the red corpuscles.

Even among the latter appeared some with nuclei, and some of these underwent at 38° to 41° Celsius, very great changes of form.

The colorless corpuscles did the same, of course, but the large ones were strikingly slower than the smaller ones.

The eyes appeared in a tolerable condition. There were on both sides small spots of pigment on the anterior part of the capsule, and on the left eye three filiform synechiæ. The appearance of the iris was pretty fair, both pupils reacted to light. The tension of the bulbs normal. The examination of vision, with moderate illumination, showed for both eyes E (Emmetropia) O. d. $S = \frac{20}{20}$; and O. s. $S. = \frac{20}{100}$. With the right eye J. No. 1 was read between 12″ and 5″; left, J. No. 5 uncertain, J. No. 6 clearly at 8″.

Ophthalmoscopic examination showed, on the right side, a condition quite similar to the above-described case of P. W.; the condition of the right eye is represented in Plate B. The color of fundus was pale orange-yellow. The yellow coloring did not disappear upon examination with daylight. The contour of the entrance of the optic nerve was, especially on its inner side, obscured, the veins

large, pale, rose-red, the closer to the pupil the more so; their contours were wanting in distinctness, the tissue of the iris, especially next to the veins, was obscured in many places, while in the other places even the small vessels and the translucent choroid could be clearly recognized. The arteries were thinner, pale-yellow, and showed in general a much sharper outline than the veins. But the most striking thing was a shining yellowish-white spot, situated almost exactly in the position of the macula lutea, about the size of $\frac{1}{4}$ D, surrounded by a dark-red margin, to which was joined towards its exterior quite a number of little roundish spots, also shining and similar in color. The figure upon Plate B represents this condition, with of course, not too great fidelity. At the examination with the upright image, and with the binocular ophthalmoscope, it could be seen with tolerable certainty that this yellow spot was prominent anteriorly, and more in the middle than at the sides.

This spot might, therefore, be considered as a small tumor. Its position could not be located to a certainty with the mirror alone. I shall prove further on that its position was rather behind than on the retina itself. It appeared clear at once that the present disturbance of vision, and the veil of which the patient complained, depended on this tumor. To arrive at a certainty, I ordered the patient to fix his eyes upon a small black cross on a dead white paper, at a distance of twelve inches. It was then seen that he had a little to the right and below the point of fixation, an obliquely oval, pretty well defined

scotoma, of the size of 2 D. In the vicinity of this scotoma all horizontal lines were so deflected, that the upper ones made a curve downwards, and the lower ones upwards. Vertical lines showed in the vicinity of the scotoma the same phenomena in a less degree, *i. e.*, those lying to the left were deflected to the right, and those on the right to the left, and between was one scarcely deflected at all.

From the position of the scotoma the conclusion might be drawn, that its cause, if in the retina at all, was situated a little above and to the outer side of the macula lutea. The position of the yellow tumor in the plate corresponds to this conclusion. However, there appeared to be a disproportion between the size of the tumor and the scotoma, to the extent of the size of a papilla. The size of the tumor was equal ¼ D, the size of the scotoma equaled 2 D. But this contradiction is explained if we consider that the effect of a small swelling crowded between the retina and the choroid, or lying in the choroid and pressing the retina forwards, must necessarily have exerted an influence upon the functions of the retina beyond the boundary of the swelling. This position of the swelling shows the character of the existing metamorphopsia.

Foerster (Ophthalmologische Beiträge, p. 27) explains, as we know, a metamorphopsia in which parallel lines are deflected from the centre of the disturbance of vision, as resulting from a process of contraction in the retina which occasions that the images of straight lines are represented upon portions of retina which in a normal retina lie at a greater distance from that central point. If it is

permitted to reverse this sentence, then must a process by which the tissue of the retina is expanded, produce an opposite result. In the normal state the retina is extended over the convex vitreous ; now if it is pressed from the side of the choroid anteriorly it will become flattened and of a less convexity. Then a condition occurs in which at a circumscribed spot the retinal elements must be on the same level. Lastly the retina will take a convex position anteriorly, and may in this way pass beyond the curvature of its normal condition, and in an opposite direction. It is obvious that when this occurs the retinal elements must be drawn asunder, while up to this moment in the change of position just described, the percipient elements must be closer together than in the normal condition. A metamorphopsia like that described by Foerster may also depend upon an exudation behind the retina pressing it forward, as long as by the anterior curvature, the outline of the retina does not surpass the normal curvature. From all this it follows that a metamorphopsia of an opposite kind, as in our case, may be explained, if we take for granted that the retina is pressed strongly forward at one circumscribed spot by a swelling lying behind it. The phenomena of micropsy and macropsy must be demonstrable according to the relations described. I am sorry that I neglected to make an examination in that respect at the proper time.

At the beginning I was more inclined to connect this peculiar state of the retina with the syphilis from which the patient had suffered than with the enlargement of the

spleen. The more so as I had not at that time examined the blood, and my attention had not been drawn to leucæmia.

The striped obscuration of the retina which accompanied many of the vessels corresponds to that which is considered by Liebreich as characteristic of retinitis syphilitica.

Only after leucæmia was diagnosticated, and the peculiar properties of the blood were recognized, I remembered the neglected observations of Liebreich on retinitis leucæmica. It seemed to me beyond doubt that I had the same condition before me which had occasioned Liebreich to describe this new form of disease. My case differed only from that of Liebreich in the size and the peculiar position of the light-yellow spot. The little tumor was therefore not to be considered as a gumma of the choroid or retina, but as a collection of white blood-globules, or, if one will, as a little lymph tumor.

I followed the course of this change of the retina with the more interest. Atropine was introduced, and iodide of iron administered internally to the patient. Not to weary the reader, I shall communicate the most important facts in the course of the general disease very briefly.

The patient remained some weeks at the eye clinic, and left it in pretty much the same condition. He was privately treated by Professor Stricker, who wished to have him at his command on account of the interesting condition of his blood. The strength of the patient slowly diminished more and more, besides he was troubled with attacks of dyspnœa and violent diarrhœa. A methodical application of cold water gave him some temporary relief. After he

had been under observation about eight months he withdrew, and probably left Vienna. Unfortunately we had no opportunity of making a post-mortem examination.

I now return to the eyes. The faculty of vision of the left eye improved rapidly. After a fortnight, vision$=\frac{20}{70}$. With a diaphragm and convex glass of $\frac{1}{15}$ he read, in spite of the atropine, J. No. 3, at 6″. Corresponding to this improvement the red halo in the periphery around the little yellow tumor disappeared, the tumor itself as well as the little surrounding round yellow spots lost their brightness and prominence, the scotoma turned pale, and the metamorphopsia was less definitely marked. By the 19th of December, vision $=\frac{20}{40}$ and J. No. 1 was read without a glass at a distance of 6–7″.

A dirty, yellow obscuration remained in the place of the little tumor, which was composed of separate little yellow spots. The red halo was entirely gone. The figure on Pl. C is an effort to represent the appearance of this spot. The scotoma was scarcely recognizable, distortion of objects not perceptible.

Central vision remained in this condition until April, 1867, when I, as far as I remember, examined the patient for the last time. Notwithstanding the great improvement of vision the patient said he saw worse with the left eye than formerly. As in the right eye normal acuteness of vision and accommodation had appeared as often as he had been examined, the assertion of the patient is entitled to full credit.

While I saw these changes in the region of the macula

lutea taking place under my own eyes, I observed accidentally at the end of January that similar little whitish yellow tumors had formed in or behind the retina, about three papilla diameters above and internal to the papilla, besides a larger vein branching out in the same situation.

They are represented on Pl. C, and relieve me from the necessity of any further description.

Quite a peculiar appearance presented itself in the neighboring vein. More obscure and less definite in outline than any other in the same eye, very tortuous and bordered on both sides by a yellow ribbon-like stripe, it appeared to me different from any thing I have ever seen except in the second case of retinitis leucæmica. (See above.)

It remains to be mentioned that the peculiar appearance commenced a short distance from the papilla. Unfortunately as accident would have it I was not able to follow up the formation of these changes. But they must have progressed very rapidly, as I examined the patient very frequently, and had not noticed any thing of them the last time I examined him. These spots commenced after a few days to disappear, and at the end of six weeks almost every trace of them had vanished. Of the histological and anatomical relations of these yellow spots we can only surmise, as anatomical examination was wanting.

However, as such examinations have been obtained from other sources, I will mention the conclusions that may be deduced from an unbiased consideration of such observations.

I shall not state any thing further with regard to the clini-

cal diagnosis of the general diseased condition of the patient. It is sufficient, if from the description of the case it is evident, that it is a case of well-marked leucæmia.

I will not decide whether it was caused by the preceding intermittent entirely, or partly also by syphilis, *i.e.*, whether syphilis had its share in producing the great enlargement of the spleen.

It is enough for me to state that the peculiar quality of the blood reminds one of the observations published by Friedreich (see Virch. Arch., vol. 41, p. 404). It is easy to conclude that in blood which is so much changed, not only the white, but also the red corpuscles which are mingled with them, have a tendency to exude more easily.

These white masses would be nothing else than agglomerations of lymphoid cells exuded from the vessels. As they retain in the tissue their mobility unimpaired, it is easy to understand that these masses may divide again after some time, as the cells pass on in different directions and become dispersed. It is not known to me whether similar collections of lymphoid cells appear in other organs in leucæmia, and it remains unexplained why the exuded cells collect in certain situations. The peculiar ribbon-like stripes beside the large vein upon Pl. C would find its explanation in this view. They are dependent upon the freshly-exuded white blood corpuscles collected along the sides of the vessel. The cloudiness already mentioned as appearing upon some of the vessels might be explained in a similar way. It is particularly difficult to decide whether these conglomerated exudations of white corpuscles which causes their accumu-

lation in larger masses takes place from the vessels of the retina or the choroid. The appearance of the retinal vessels, as likewise of the place of the second spot in the neighborhood of the larger vein, would indicate that it proceeded from them. But the position of the spot in the immediate neighborhood of the macula lutea, which is represented on Pl. B, hardly agrees with this supposition.

Again, it must appear surprising that many small lymphoid bodies have collected just at a spot where few or no vessels are found. It is also difficult to explain that if all these cells are situated in the tissue of the retina that it should not have lost its function. But we have seen above, that there is still vision at this spot, although the outlines of objects are distorted, and the acuteness of vision is considerably diminished in the immediate neighborhood, *i. e.*, at the macula lutea. For this reason it appears more probable to me that here the vessels of the choroid had furnished the mass of the cells. There needs no further explanation of the general and peculiar color of the fundus, which may be deduced from the peculiar color of the leucæmic blood circulating in the choroid, and the whole image which the fundus exhibits in leucæmia may be inferred in the same way from the altered quality of the leucæmic blood, as the color of the fundus is directly dependent on the changed color of the blood, and, further, the dim-yellow appearance of the arteries corresponds to the pus-color of the blood, while the rose-colored appearance of the veins depends upon the difference which likewise takes place in leucæmia between arterial and venous blood.

The size of the veins, their swollen indistinct appearance, the white stripes on their sides, and the partial cloudiness of the retina which accompanies them, all find their explanation, if we bear clearly in mind the process of a large exudation of white corpuscles by which the vessels themselves are plugged up, while others stick fast in the walls, and a greater or less number are exuded. Why the cells now and then collect in the tissue or between the retina and choroid in greater numbers, remains of course unexplained. It will be seen that I have endeavored to give the explanation of the ophthalmological appearances according to Cohnheim's view of the nature of inflammation. If this view is accepted as correct, and proven, there can be no hesitation in considering such appearances in the fundus of leucæmic persons as the consequence of an inflammatory process; and as in every case the retina suffers, as is proved by the appearance of its vessels and the cloudiness of its tissue, there can be no objection to the designation of retinitis leucæmia or retinitis from leucæmia. It remains, nevertheless, very surprising that, as I have stated from the beginning, the observations of Liebreich have been so seldom confirmed. When I conversed with Liebreich a year ago on this subject we arrived at the conclusion that retinitis leucæmica has so far been so seldom observed because it has not been looked for. When I made a similar observation at the Ophthalmological Congress in Heidelberg, 1868, Knapp replied that he had looked for it but had not found it.

I too have since had the opportunity of examining a case of well-developed leucæmia at the clinic of Prof. Friedreich

without being able to discover the least alteration in the fundus of the eye. It remains therefore still undecided why in one case the change of color and the exudations are found, and not in another, although it is natural to attribute it to the difference of the disease which causes it, leucæmia itself, or differences in the quality of the leucæmic blood. This is the reason why I have communicated in the case related the history of the disease with such minuteness. From the same it may be seen that even in this case the retinitis leucæmica could have been overlooked if the local changes had not taken place exactly in the spot of direct vision. Only to this peculiar circumstance I am indebted for the opportunity of observing the case.

The object of the preceding article will be accomplished if pathologists and our special colleagues are led to examine all cases of leucæmia with the ophthalmoscope.

Numerous observations must at last lead to the knowledge of the special conditions under which leucæmia produces inflammation of the retina. Besides, it is not improbable that from ophthalmoscopic examinations valuable discoveries may be made in special cases of leucæmia.

Explanation of the Plates.

Plates B and C are drawn from the inverted image, and taken from the left eye. The representation on Pl. B was sketched in the beginning of December, 1866; that on Pl. C, about nine weeks later.

A CASE OF PYÆMIA FROM SUPPURATIVE INFLAMMATION OF THE CAVITY OF THE TYMPANUM, INDUCED BY THE USE OF WEBER'S NASAL DOUCHE.

BY D. B. ST. JOHN ROOSA, M. D.,

Clinical Professor of Diseases of the Eye and Ear in the University of New York.

On the 12th of December, 1868, I was consulted by a clergyman of forty-nine years of age, at the instance of his family physician, J. Foster Jenkins, of Yonkers, N. Y., in regard to a subacute catarrh of the cavity of the tympanum, affecting both sides of the head. The history of the patient was as follows: Some three years before he was attacked with what seemed to be hay fever, or a form of coryza attacking certain persons during the summer. This coryza was not relieved by any treatment, although a voyage to Europe was included among the means employed, but it became a chronic catarrhal inflammation of the naso-pharyngeal region, attended by the usual symptoms, viz., a sense of stuffiness of the nostrils, frequent expectoration, sneezing, &c. For the past two months the patient had been in the daily habit of using Weber's nasal douche for the purpose of cleansing the nostrils, and of introducing remedial agents into them. He had once before tried this means of treatment, but it had caused so much unpleasant feeling in the ears, that he was obliged to desist

from employing it. For about two weeks these unpleasant sensations on using the douche have been again experienced. The patient complains of being deaf, and of having a full sensation in both ears, almost amounting to pain. The membrana tympani of each side is found to be reddened. An ordinary ticking watch, heard by a person with normal hearing power about six feet, is only heard when placed in contact with the auricle of each side. A leech was applied to each ear, on the tragus, the Eustachian tubes were rendered pervious by means of the catheter and Politzer's method. In a few days the membrana tympani assumed a normal appearance, and the hearing was restored by means of this treatment.

The patient then desired that an attempt should be made to relieve the trouble in the naso-pharyngeal region. The uvula and tonsils were relaxed, the whole mucous membrane of the upper pharyngeal space secreted excessively, and the patient had contracted a habit of constantly endeavoring to clear his nostrils. Fluids passed through the left nostril, but none through the right. The Eustachian catheter, however, passed without difficulty. The nostrils were cleansed by means of a nebulizer, salt and water being used in it, after which the parts were swabbed out with a solution of *Arg. Nit.* gr. x, ad ℥i. The patient improved under this treatment until Jan. 28th, when he was for some time exposed to the air of a winter's day, with the head uncovered (at the consecration of a bishop), when the symptoms, which had been to a certain extent relieved, returned. Jan. 31st, a gelatinous mass was found plugging up the inferior meatus of the right nostril, seeming to be attached to the floor of the canal. Portions of this were removed by torsion, at intervals of about three days, until Saturday, Feb. 6th, when what seemed to be the remainder of this growth was removed. The patient left the office, saying that his nostril was much clearer, and went to Yonkers, a town about ten miles by rail from New York. He there again used the nasal douche, and again experienced a decidedly unpleasant

sensation in his ears, which, however, did not amount to pain. On Sunday morning and evening the patient performed his clerical duties, but with a great sense of languor and uneasiness. On Sunday night, February 7th, at about eleven o'clock, he was awakened by a severe pain in the mastoid region of the right ear, which kept him from sleep. I saw him Monday morning at about eight o'clock, and noted the following symptoms:—The countenance was anxious and flushed, skin hot, pulse about ninety-six, right mastoid region red and sensitive, right membrana tympani reddened, watch only heard when pressed upon the auricle. The patient was asked as to the condition of the left ear, but he said there was no trouble there. An examination of the tragus and mastoid process failed to exhibit any symptoms of inflammation in that ear. Two leeches were ordered to be applied to the mastoid process, and the patient was to take *aq. acetat. amm.* At 5 P. M. the pain in the ear had entirely ceased after the application of the leeches. The patient was breathing hurriedly, however, his pulse was weak and frequent, about ninety-six, and he complained of pain and tenderness in the abdominal region. Morph. Sulph. gr. $\frac{1}{8}$ was ordered to be taken *pro re nata*, and a poultice was applied over the abdomen.

Tuesday, Feb. 7.—The patient took two powders of morphine and passed quite a comfortable night. This morning he complains of pain in the forehead, but has none in any other part of the body. The surface of the body is dry and hot. Ordered *aq. acetat. amm.* and nutritious diet.

Feb. 8.—Last night the patient was attacked by a severe pain and swelling of the left foot, and at about $7\frac{1}{2}$ A. M. he had a severe chill, lasting about fifteen minutes; not followed by sweating. At about this time a discharge appeared from the left ear. There has been no pain experienced in this part. He has not slept well, and his general appearance is bad. Countenance anxious. Breathing labored. Pulse about 96. The left ankle and dorsal region of foot

are red, greatly swollen, and tender. *Left* membrana tympani ulcerated and discharging freely.

Dr. Foster Swift, of this city, was called in consultation, and the following treatment agreed upon. The foot was wrapped in an alkaline lotion, Vichy water was given *ad libitum*, with beef-tea and wine, morphine *pro re nata.*

Feb. 9.—Patient does not seem so well. Respiration is hurried. The intellect is somewhat clouded. Pulse about the same. Face of a sallow hue. The stimulants are increased so that he now takes half an ounce of brandy in milk punch every four hours, day and night. Quin. sulph. gr. 2, every four hours. The left ear is syringed with lukewarm water, *Zinc. Sulph.* applied, and Politzer's method used to inflate the drums. The patient is so deaf, that he only hears when spoken to near the ear.

The patient was treated in this manner, until Feb. 22, the brandy punch being steadily increased until he was taking two ounces every four hours, with beef tea, eggs, &c. His pulse was never over one hundred, usually about 96, the skin had a saffron hue, and patient lay in a doze, except when the pain from his foot kept him awake nearly the whole time. *Dr. George A. Peters*, surgeon to the New York Hospital, was called in consultation, a few days ago, in addition to Dr. Swift and myself, and to-day two openings were made in the foot, one near the internal, and one near the external malleolus. Pus was evacuated. The dorsal region of the foot was very much swollen, but no fluctuation was detected. The patient's general condition is now better. His countenance less anxious, the respiration is not so hurried. The urine was several times carefully examined during the treatment. No abnormal condition was found, beyond an acid reaction early in the course of the disease.

Several openings were made in the foot from time to time, but the patient slowly improved from this time until March 16th, when he

was able to sit up. The membrana tympani healed, and the hearing distance became about one foot on the right side, and four to six inches on the left. Conversation is heard with ease, Politzer's method has been practised every two days. *Quinine* and *Iron* have been taken in addition to the stimulants. The foot is still swelled, but all the openings but two have healed.

April 4.—The patient has been going about the house for a week. Hearing power is still further improved. A little erysipelatous soreness of the foot occurred last night. The naso-pharyngeal catarrh is completely gone.

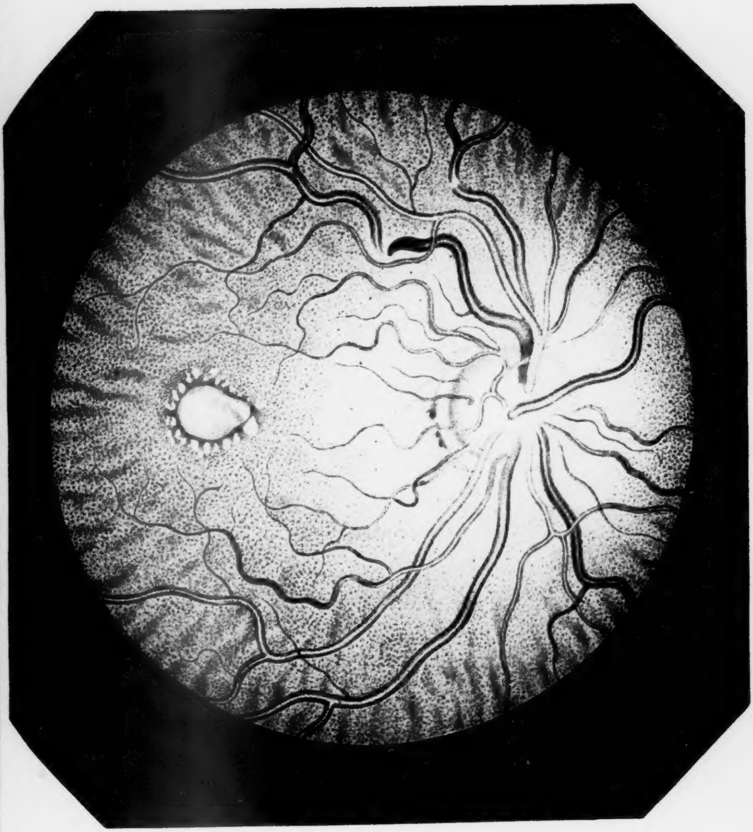
April 7.—Patient rode out to-day, and gets about the house, employing himself in intellectual labor. Tissues of the foot still swelled and rigid—motions of the ankle-joint unimpaired.

REMARKS.

The foregoing history seems to indicate that this was a case of metastatic abscess, arising from the suppurative inflammation of the left membrana tympani. The exciting cause of the aural inflammation was, I think, the use of the nasal douche. I am the more inclined to believe this from the fact, that on two previous occasions, I have seen the employment of the douche cause considerable trouble in the ear. In one instance the drum was ruptured by its use. I have seen few cases where the use of the douche could be tolerated for any length of time. Its daily employment is very often attended with great discomfort. Instead of the douche I use the posterior nares syringe, which is safe, and pleasanter to the patient than Weber's method. Judging from the sensations described by the patients who use the douche,

it is probable that fluid passes through the Eustachian tube into the cavity of the tympanum, and thus becomes a cause of inflammatory action.

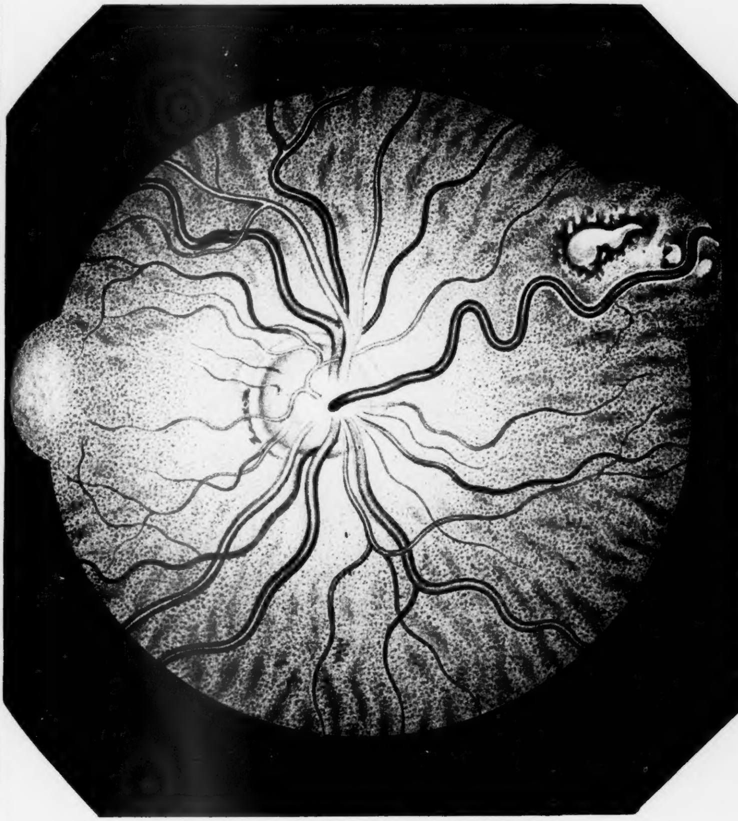
Metastatic abscesses occurring from chronic otorrhœa, which has suddenly taken on an acute form, are not very rare; but I believe that few cases have been recorded where such a purulent infection took place during a primary affection, and certainly none have been published where the use of the nasal douche was considered the cause of the aural inflammation.



Retinitis leucaemica I.

Dr C. Heitzmann ad nat. del

Carlsruhe _ Chr. Fr. Muller'sche Lith. Anstalt.



Retinitis leucaemica II.

Dr C Heitzmann ad nat del.

Carlsruhe _Chr. Fr. Müller'sche Lith. Anstalt.

Tab. I.

Fig. 1.

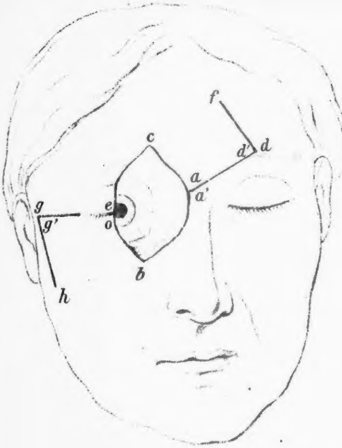


Fig. 2.

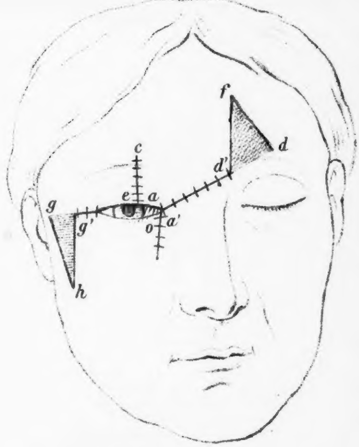
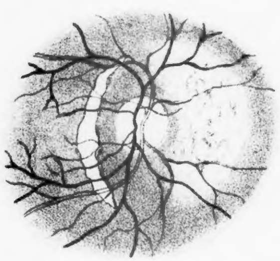


Fig. 3.



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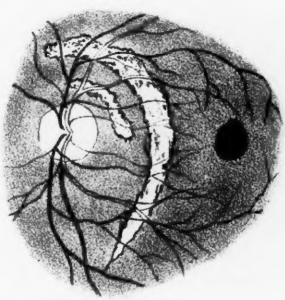
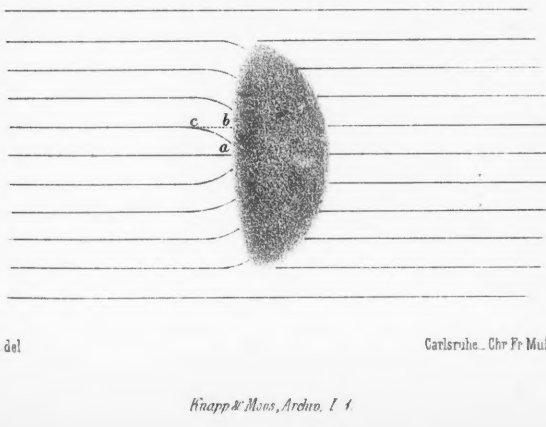


Fig. 4. A.



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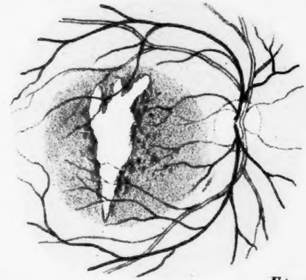
Carlsruhe _ Chr Fr Muller'sche Lith. Anstalt

Tab. II.

Fig. 4. B.

Fig. 5.



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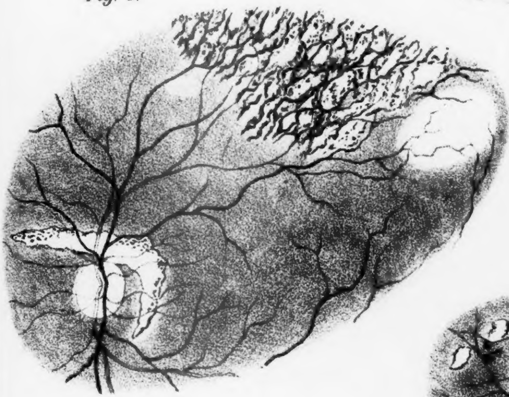

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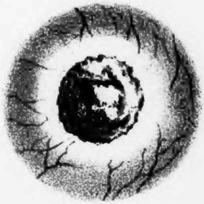

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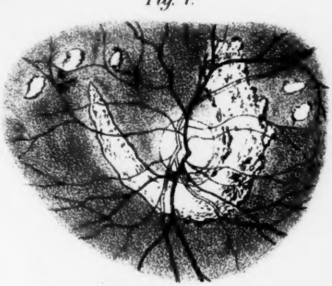

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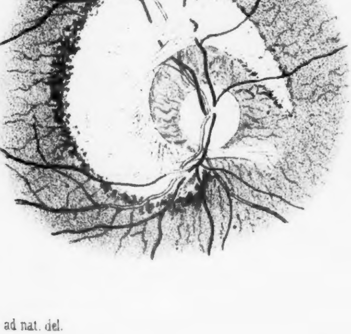

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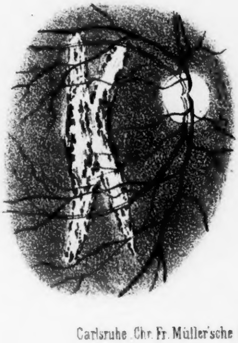
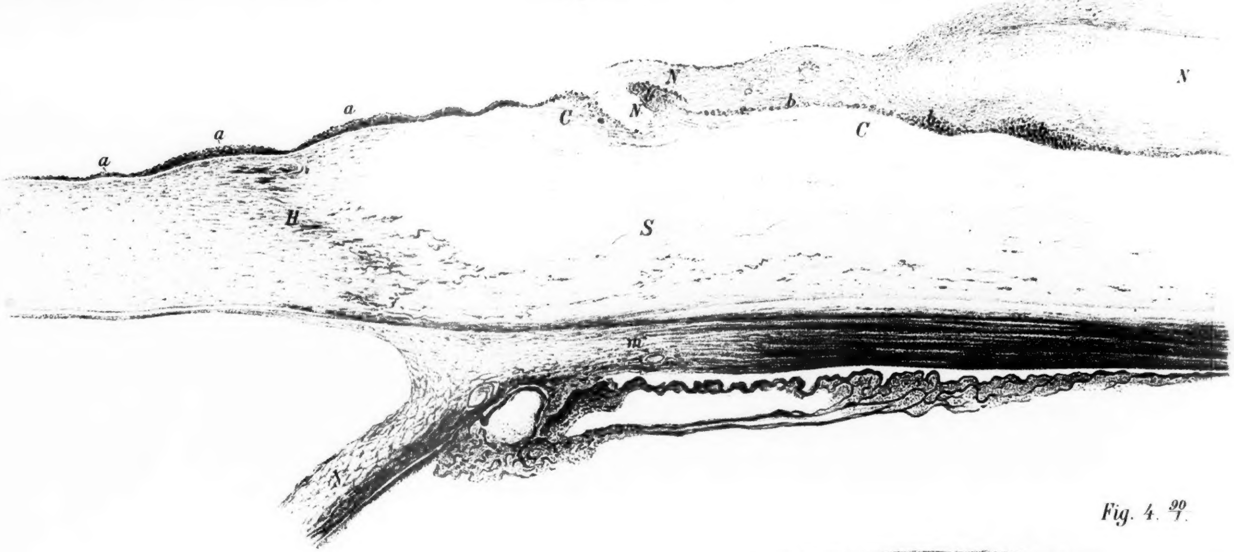


H. Knapp ad nat. del.

Carlsruhe. Chr. Fr. Müller'sche Lith. Anstalt.

Fig. 1. $\frac{90}{1}$.



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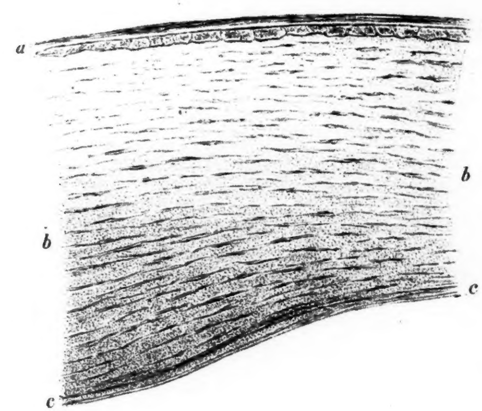

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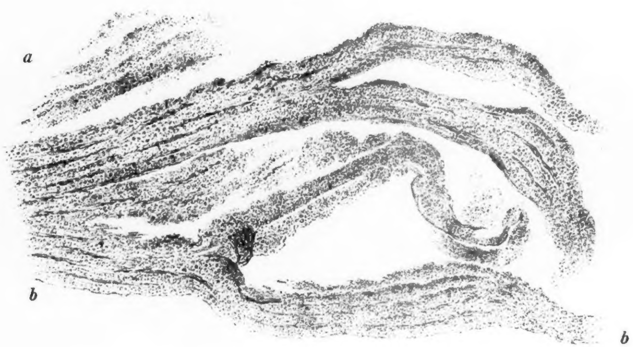

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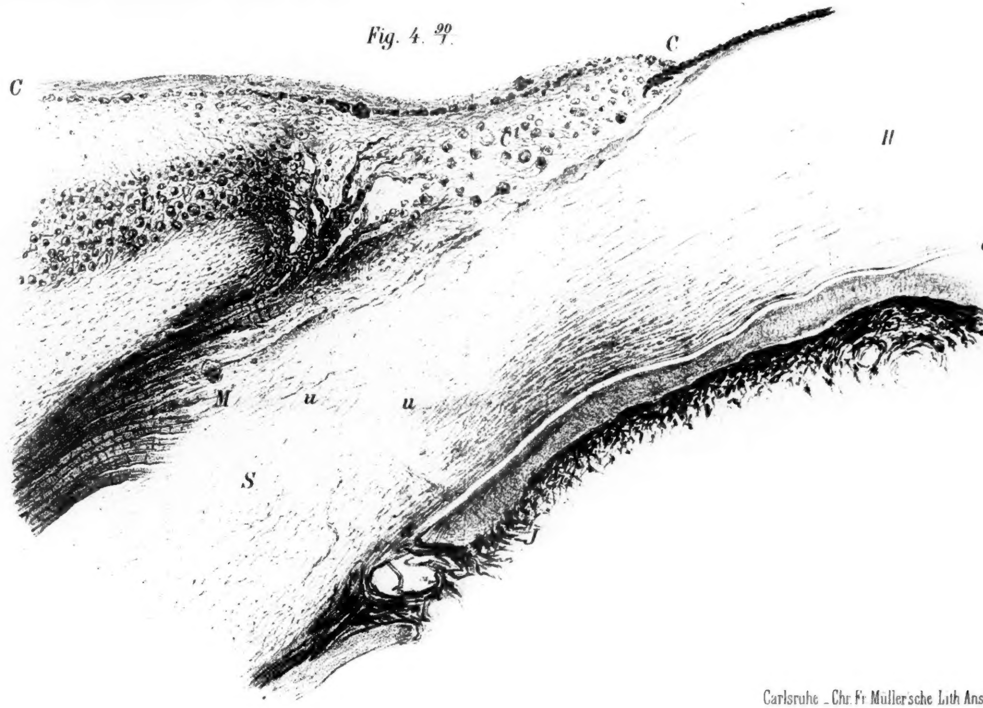
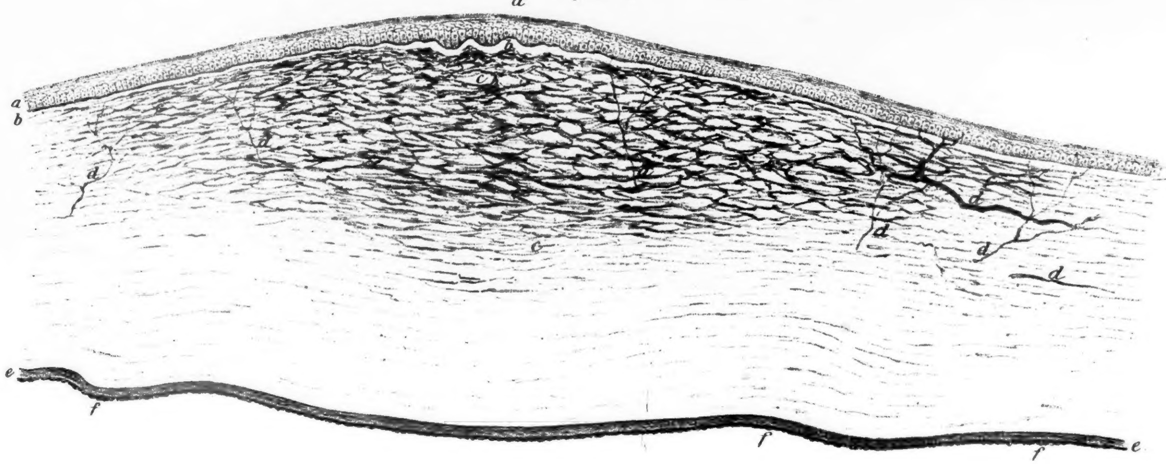


F. Veith ad nat. del.

Carlsruhe _ Chr. Fr. Müller'sche Lith. Anstalt.

Fig. 5. $\frac{90}{1}$

Fig. 6. $\frac{90}{1}$



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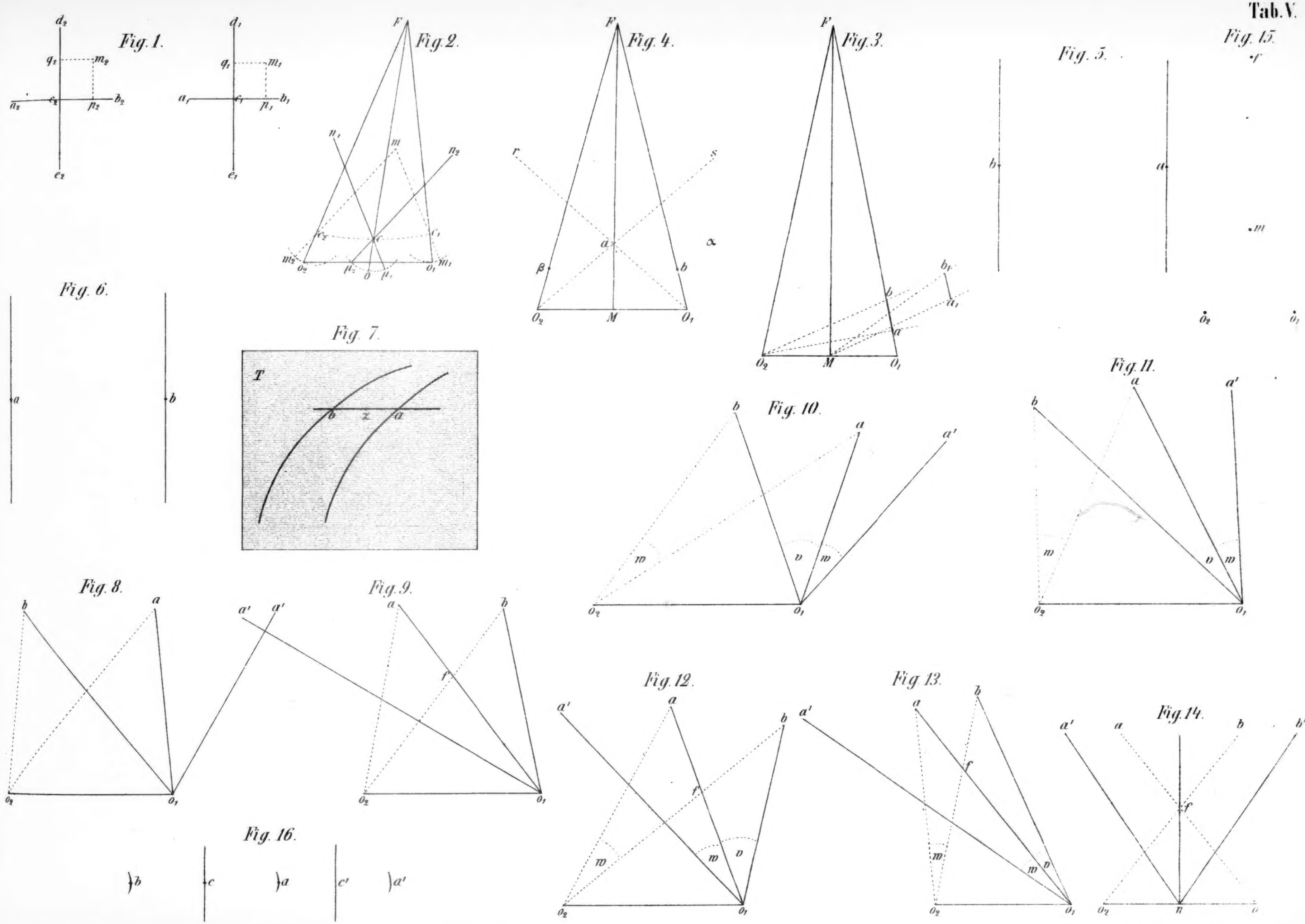
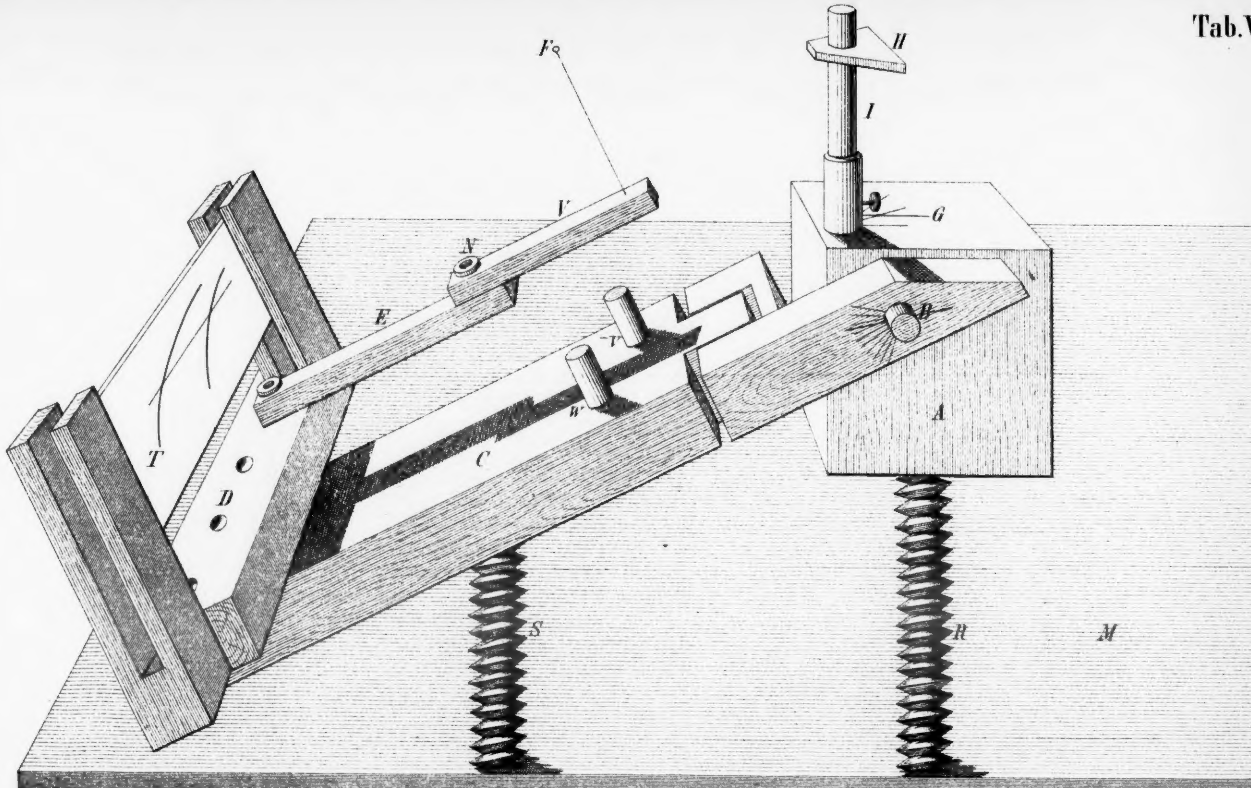
Tab. V.



Knapp & Moos Archiv I 1

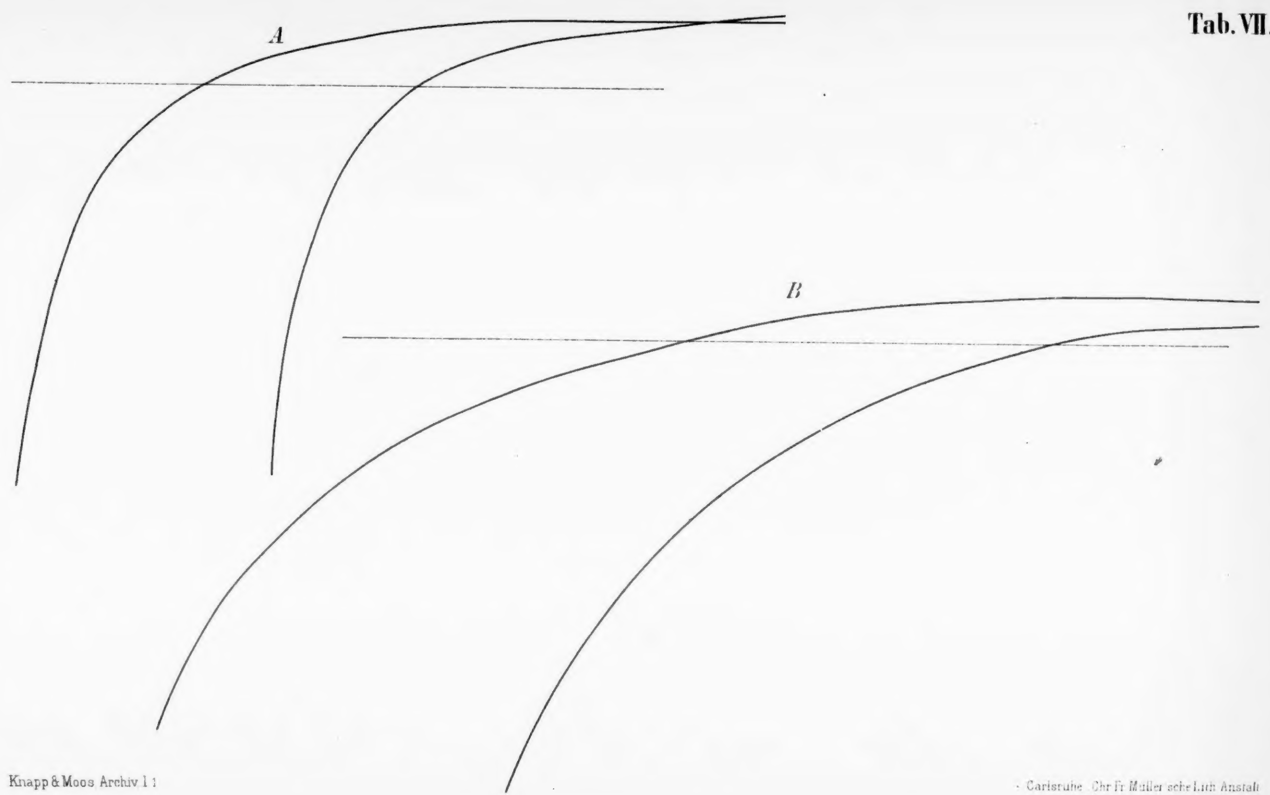
Carlsruhe. Chr. Fr. Müller'sche lith. Anstalt.

Tab.VI.



Carlsruhe Chr. Fr. Müller'sche Lith. Anstalt

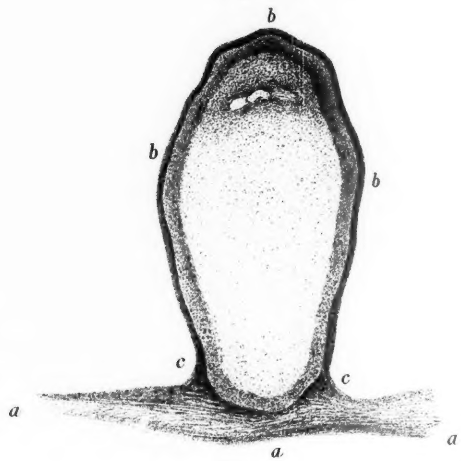
Tab. VII.



Knapp & Moos Archiv I 1

Carlsruhe Chr. Fr. Müller'sche Lith. Anstalt

Fig. 1. $\frac{26}{1}$



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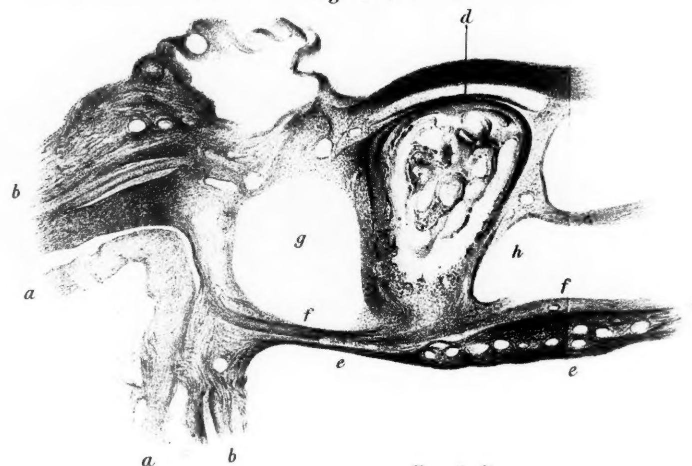

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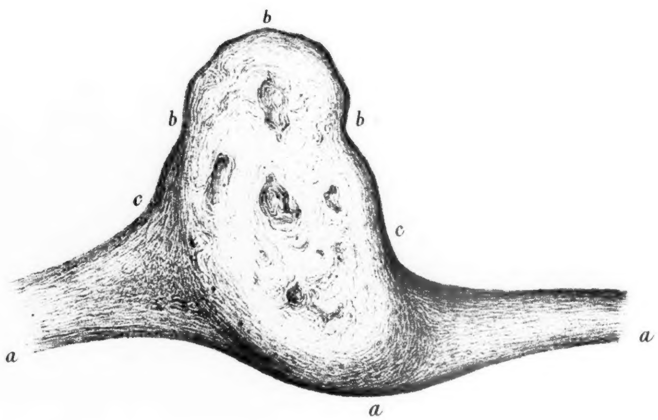

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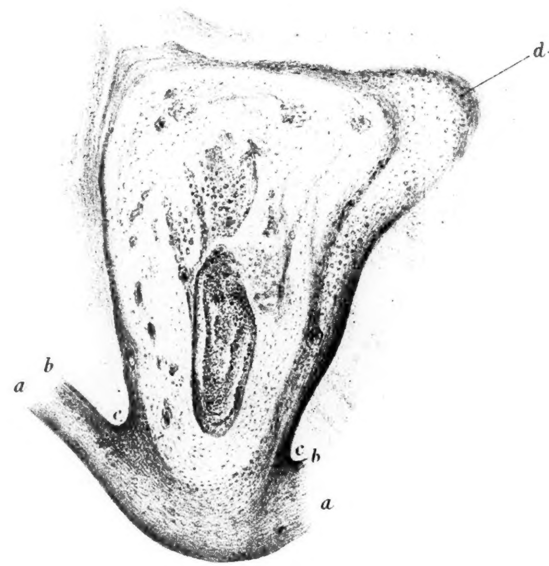
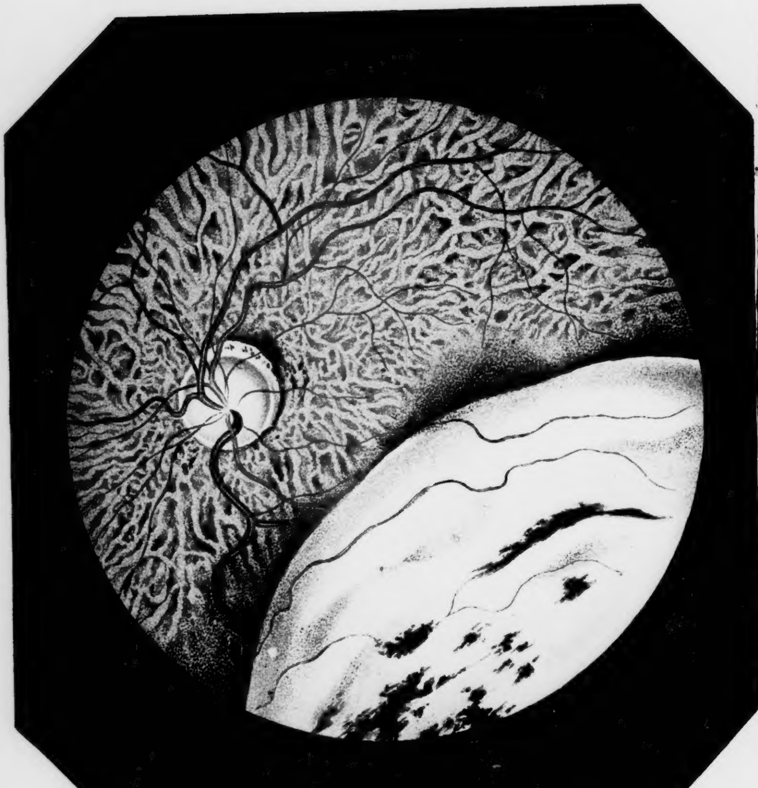


F. Veith ad nat. del.

Carlsruhe – Chr. Fr. Müller'sche Lith. Anstalt.



Sarcoma chorioideae I

Dr. C. Heitzmann ad nat. del.

Carlsruhe. Chr. Fr. Muller'sche Lith. Anstalt